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## *OPENING OF THE EAST WING OF THE AMERICAN MUSEUM OF NATURAL HISTORY.*

THE opening of the east wing of the American Museum, upon November 30th, marks the latest step in its rapid development. The old wing of the building, completed in 1873, contained 35,020 square feet. With the west wing, now in course of erection, the Museum will have a total exhibition floor space of 148,258 square feet. The construction of the east-corner wing has been authorized by the Legislature, and this will nearly complete the south façade in 1900.

The Twenty-seventh Annual Report of the President, recently issued, shows that the last two years have been of exceptional activity in the development of the collections and educational work of the Museum. During 1895 seventy-five thousand dollars was received from the city of New York for maintenance, and sixty-five thousand dollars from the Endowment Fund; there was, however, a deficit of nearly eight thousand dollars on these two accounts, which was met by special subscription from the Trustees. The expedition in Peru under the direction of Mr. Adolph F. Bandelier, referred to in previous reports, has been eminently successful, and arrangements have been made to continue his work until the close of 1896. The expedition to Honduras was made in cooperation

with the Peabody Museum at Cambridge, the latter Museum having a concession from the government of that country. Mr. Rudolph Weber returned early in the autumn of 1895 from Sumatra, where he has been collecting for the Museum with a fair degree of success. Dr. Lumholtz has continued his explorations among the Indian tribes of the Sierra Madre Mountains, adding greatly both to the collections and to our knowledge of the primitive people in that region. Another interesting collection is from the cliff houses and burial caves of Utah, presented by the Messrs. Hyde, who have not only given their collection to the Museum, but have also arranged to continue their explorations in the Southwest for several years, under the general direction of the Curator. The Peary Relief party sent out in coöperation with the American Geographical Society, included a thorough and skilled collector, and the numerous specimens obtained through this source were added to the Department of Mammals and Birds. Mr. Joseph F. Loubat has supplemented his previous donations with a gift of the widely-known 'Charnay' casts of sculptures from the ruins of Tikal, Guatemala; Manché, Chichen-Itza and Uxmal, Yucatan, and from Palenque and other localities in Mexico.

The Curators in the various departments of the Museum have been occupied for several months preparing for the opening. Every department has received notable additions. The two new halls which were opened for the first time, those of Ethnology and of Vertebrate Paleontology, deserve epecial description.

The Fossil Mammal Hall is upon the third floor of the new east wing of the Museum, and has been arranged under the direction of Prof. Henry F. Osborn, Curator, assisted by Dr. J. L. Wortman and Dr. W. D. Matthew. The department was established by the Trustees in 1891, and a generous annual appropriation from the Museum endowment fund, supplemented by many private gifts, has resulted in bringing together a remarkably complete collection. The field parties under Dr. Wortman have spent from six to eight months each year in the West, exploring especially the Puerco, Wasatch, Wind River, Bridger, Washakie, Uinta and White River formations and the *Aphelops* bed of the Loup Fork. Up to the summit of the Oligocene, the collection is unique, containing, with a few exceptions, more or less complete remains of every genus and species known. Negotiations were early begun for the famous collection of Prof. Cope. This was purchased and removed to the Museum in 1894; it includes 550 types and a number of complete skeletons. Altogether the collection includes twenty-five complete skeletons. Six of these have already been mounted, under the direction of the preparator, Mr. Adam Hermann.

A zoological arrangement of the Hall was early decided upon as the most practicable, also as the most interesting and effective in the education of the public. The entire right, or south side of the Hall, is devoted to the Perissodactyla, beginning with the Titanotheres. The evolution of these animals is illustrated by finely mounted skeletons of *Palæosyops* and of *Titanotherium*, and by a remarkable display of Eocene and Oligocene types, illustrating the complete development of the skull. Further on are the Rhinoceroses, the three diverse types of cursorial, semi-aquatic and land types being represented by mounted skeletons of *Hyracodon*, *Metamynodon* and *Aceratherium*. The horses complete this series at present.

On the north side of the Hall are the Mesozoic mammals, then the meseutherian Amblypoda and Creodonta, the Tillodontia, Rodentia, Insectivora and Carnivora. The Proboscidia occupy the north center, followed by the Artiodactyla, which are at

present v imperfectly arranged. A special feature of the opening of the Hall is the exhibit of the series of Ganodonta, or Edentates with enamelled teeth, which demonstrate the early presence, if not the origin, of this great group in North America.

Great attention has been devoted to the labels, and most of the mounted skeletons are accompanied by large water-color drawings, executed by Mr. Charles Knight, which convey an approximate idea of the living form of these various extinct types.

In the ethnological collections an attempt has been made to elucidate all the principal aspects of the culture of each group. Consequently the material is placed in geographical order, each cultural area being treated as a unit. Whenever the collections are sufficiently complete the following subjects are illustrated: Physical types of the people, the relations of man to nature; manufactures and industries; household furnishings; dress and ornament; travel; methods of obtaining food supply by hunting, fishing, stock raising or agriculture; warfare; trade and barter; games music; plastic art; social organization; religion. This plan has been carried out most fully in the largest and most important collection that the Museum possesses, namely, that from the North Pacific coast of America. The larger part of this collection was made by Lieut. G. T. Emmons on his travels in southern Alaska during the past 15 years. The culture of the Indians of British Columbia is represented by material given to the Museum by Mr. Heber R. Bishop and collected by Dr. J. W. Powell, formerly Superintendent of Indian Affairs of British Columbia. In the first section of the exhibit, the relation of man to nature, the use of natural products is illustrated. Objects made of cedar show the multifarious uses of this tree. The uses of other trees and plants, and, further on, those of animals, stones and metals, are shown in the same manner.

Life-size groups bring home the most important and characteristic occupations of the people. Thus we have one domestic scene showing the preparation of objects made of cedar. A woman is breaking cedar bark which is to be used for making towels, aprons or blankets. Another woman is weaving a mat and rocking her baby, lying in its cradle, which is suspended from a cedar branch. A second group illustrates work on the beach in front of the house. There are men splitting logs and a woman preparing to go on a canoe journey.

Most of the other sections of the exhibit, except one or two, require no further comment. As far as feasible, dress and ornaments are shown on busts or full figures. Thus a figure of a tattooed man will be found; busts fitted with labrets, nose rings and ear ornaments; a figure of a warrior in full costume; and these are supplemented by the figures composing the groups.

Special pains have been taken to illustrate the principles underlying the conventionalism of these tribes. One case is devoted to the general treatment of the animal form, while others show representations of the same animal in various materials and on objects of varying form, thus elucidating the influences of technique and of the form of the object to be decorated upon the conventionalized representations. In another section objects illustrating totemism are shown, while that of religion embraces the paraphernalia of the shaman and of secret societies.

The physical types of the Indians of this region are illustrated by means of busts, photographs and skulls and skeletons.

In this whole systematic exhibit, which fills a series of eight pavilion cases, duplicates which do not help to elucidate the object of the exhibit have been excluded most rigidly. These are combined in a study

collection which is exhibited in desk cases which are so placed that the contents of each case supplement the contents of the pavilion cases.

The collections from the North Pacific coast fill the whole east side of the Ethnological Hall. On the west side we find collections from the interior of British Columbia, from Arctic Alaska, the Peary collection from North Greenland, the Lumholtz collections from northern Mexico and that part of the Sturgis collection which illustrates the culture of the Melanesians. So far as possible, these collections are arranged on the same principle as the preceding one. The collection from the interior of British Columbia is a recent acquisition of the Museum. It illustrates the culture of the Thompson River Indians, and was made by Mr. James Teit. The material is very valuable, since it is the only existing representation of a culture which has almost entirely disappeared, as the Indians during the last twenty years have rapidly adopted customs and costumes of the whites.

The importance of the Peary collection, a gift of Mr. Morris K. Jesup, President of the Museum, lies in the fact that the tribe whose culture it represents has had very little contact with the whites, so that it is more primitive than most material that has recently found its way into museums. The costumes, industries and utensils of this tribe are represented exhaustively.

The value of Dr. Lumholtz's collection from northern Mexico can hardly be overestimated. Here we have for the first time a fullness of material, bringing before us the ideas and products of the inhabitants of the mountain fastnesses of northern Mexico. The people appear hardly influenced by ideas of the whites. Their offerings to their gods, their altars, and their gods show us a culture that reminds us forcibly of the tribes of the Southwest as well as of the ancient Mexicans. It is to be hoped that the results of Dr. Lumholtz's observations, who undertook his explorations in behalf of the Museum of Natural History, will yield rich information on this interesting region.

The Sturgis collection has been familiar to visitors of the Museum for a long time. Its chief merit lies not so much in a full and systematic representation of the culture of the natives of the South Sea Islands as in the number of beautiful old pieces that it contains. On account of lack of space only part of the collection is exhibited at present.

A number of miscellaneous collections, among which one from the Indians of Guatemala deserves special mention, are temporarily arranged in the gallery of the east wing of the Museum. After the completion of the west wing of the building, which is now in process of construction, these will be removed to the ground floor of the new wing, which adjoins the present Ethnological Hall. Approximately one-half of the ethnological collections of the Museum will remain in storage until the new Hall will become available. After its completion the present Hall will be devoted to North American ethnology exclusively, while other collections will find their home in the new Hall.

A portion of the archæological collection is exhibited in the upper hall of the main building pending the completion of the new west wing. During the past few years these collections have grown rapidly, one of the most noteworthy additions being that from Peru, the result of the explorations made by A. F. Bandelier, under the auspices of Mr. Henry Villard, and later under the Museum. Mr. Bandelier's explorations have given us one of the most complete archæological collections from Peru and Bolivia to be found in any museum in the world. The collection of pre-historic textile fabrics is exceedingly interesting and valuable.

The nucleus for a good Mexican collection has been made, and there are exhibited collections illustrating the culture of several of the civilized tribes of ancient Mexico, the Nahuas, the Zapotecas, Mixtecas, the Mayas, and Tarascos. In northern Mexico the expedition under Dr. Lumholtz has given the Museum a most complete collection of the ceramic art of the old Pueblo stock of Casas Grandes in Chihuahua. In our own country a recent acquisition is that of the Hyde collection of antiquities from the cliff dwellings and ancient pueblos of New Mexico and southern Colorado. This collection will be largely increased by the exploration of ancient pueblos carried on by the Messrs. Hyde during the present year.

There is on exhibition the Mearns collection from cliff dwellings in the Verde valley, Arizona, which is one of the first made in this region. Recent explorations carried on under the auspices of the Museum have given it an interesting series of objects from the village sites and burial places of the Ohio valley. A small portion of the famous Squier and Davis collection from the mounds of Ohio was acquired by the Museum some years ago and is shown in the Ohio valley exhibit. The Jones collection from the Southern States is quite complete and many of the specimens were figured by Mr. Jones in his well-known work on the Southern Indians. A small collection from New York State and the material obtained on Staten Island at a burial place at Tottenville will interest those who are studying the Indian remains in the vicinity of New York. The Chenoweth and J. Bradley James collections from New York City are also shown. California and the West are represented by the Terry collection. During the year the Museum has been carrying on a thorough exploration near Trenton, N. J., in order to secure an authentic collection from this most important region in relation to the very early occupation of the Atlantic coast by man. Many specimens have been obtained during this exploration, but they cannot be exhibited until the new halls are ready. Owing to lack of space many other interesting objects and collections are in storage, awaiting the completion of the new wing.

On the walls of the ground floor of the main building is the well-known collection of Charnay casts of prehistoric sculptures from ancient cities in Mexico and Central America, recently presented by the Duke of Loubat. Among these is the famous Tablet of the Cross from Palenque.

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### *THE INFLUENCE OF LIGHT UPON THE DISCHARGE OF ELECTRIFIED BODIES.*

OF the many interesting phenomena that are continually being discovered in all branches of physical science, none are more important than those which point to the existence of hitherto unknown relationships between the different branches of physics; for it is by the careful study of such relationships that we may hope to proceed most rapidly with the further development of the science. This fact has been generally recognized by investigators, and the attempt to find new relations between apparently isolated classes of phenomena has led in the past to many important discoveries. The discovery by Oersted of the magnetic action of the current may be cited as one well known example.

In recent years the theory of light has gained greatly by the recognition of the close relationship between optical and electro-magnetic phenomena. The discovery by Faraday of the magnetic rotation of the plane of polarization afforded the first experimental proof of a relation between light and magnetism; the fact that certain dielectrics become doubly refracting when subjected to electrostatic stress (Kerr) indicated a connection between light and electrical phenomena; while the experi-

ments of Hertz upon electric waves have given to the electro-magnetic theory of light a standing almost equal to that of the most firmly established physical theories.

In 1887 still another class of electro-optical effects was discovered. It was then found that the passage of a spark between the terminals of an induction coil takes place more readily when the negative electrode is illuminated by ultra-violet light. The original observation, which was made by Hertz in the course of his experiments on electric waves, has since been abundantly confirmed. It appears that ultra-violet rays possess the power of assisting the discharge of negatively charged bodies, the magnitude of the effect being dependent upon the surrounding medium as well as upon the nature of the charged surface. Within the last few years Elster and Geitel have shown that the same effect is in some cases produced by the visible rays. The phenomenon has gained additional interest from the discovery by Lenard that a similar discharging power is possessed by the cathode rays, and this similiarity has been cited by Jaumann in an attempt to develop a theory of cathodic radiation. Still more recently it has been found that the effect is produced by the X-rays in yet more marked degree.

In spite of the comparatively short time that has elapsed since Hertz's original discovery, the literature of the subject is quite extensive. Strangely enough, only a few of the more important papers have been publshed in English, so that it is a matter of some inconvenience to learn just how far our knowledge of the phenomenon has progressed. For this reason, and in view of the evident importance of the subject, the writer has prepared the following account of the investigations which have thus far been published.*

* For a very brief account, see J. J. Thomson, Recent Researches in Electricity and Magnetism, p. 58–62.

DISCOVERY BY HERTZ.

1. As already mentioned, the phenomenon was first observed by Hertz* in 1887. The discovery was made during the progress of some of his earlier experiments upon electro-magnetic waves, and was purely accidental. In investigating the field near a Hertzian oscillator by means of an ordinary resonator some difficulty was met with in observing the faint sparks which occurred at the resonator. With the thought that observations could be more readily made in the dark, the resonator spark gap was surrounded by a box of non-conducting material; but it was found that the sparks were now fainter than before, and that the maximum sparking distance was noticeably diminished. On removing successively different parts of the box it appeared that only those portions lying between the primary and secondary spark were effective. The distance of these portions from the spark gap was immaterial; if the secondary spark was adjusted to its maximum length the interposition of a screen at any point between the primary and secondary spark caused the latter to cease.

2. At first thought it doubtless appeared natural to ascribe the effect to some electrostatic or electrodynamic action. Hertz was quickly convinced, however, that this could not be the true explanation, for the screening effect was produced as well by insulators, such as rubber, glass and paraffin, as by conductors. Again, although the phenomenon was first noticed when the sparks used were those of an oscillator and resonator, yet equality in the vibration periods of the two sparks was not essential. When two sparks were simultaneously produced by any other method the effect was still observed.

3. The most convenient means of study-

* Berliner Akademie, June 9, 1887. Wied. Ann. 31, 983.

ing the phenomenon was found to be by the use of two induction coils, whose primary circuits were placed in series with the same interruptor. During most of Hertz's observations the distance between the two coils was about 50 cm. The larger or 'active' spark was about 1 cm. long, while the length of the smaller or 'passive' spark was not far from 1 mm. Although especial attention was directed to the influence of the larger spark upon the smaller, it was proved conclusively that the action was reciprocal. The maximum sparking distance of each spark was increased by the presence of the other.

4. Making use of this apparatus Hertz investigated first the influence of changes in the character of the active spark, and found that the effectiveness of the latter was independent of its form. The spark could take place between spheres, or between points; could be short and straight, or long and zigzag; could be brilliantly white, or violet and almost invisible. In all cases its action upon the passive spark was practically the same. By screening successively different parts of the spark gap, it was shown that all portions of the active spark participated equally in the effect. A change in the metal of which the electrodes were made was also without noticeable influence.

5. On the other hand, the sensitiveness of the passive spark appeared to depend greatly on its character. Long zigzag sparks between points were scarcely affected at all by the presence of the active spark. The influence of the latter was best shown in the case of short sparks (1 mm. long) between brightly polished spheres of about 5 or 10 mm. diameter. Different parts of the passive spark appeared to be sensitive to the effect in different degrees. By screening various portions of the spark gap it was found that the effect was much greater when the negative pole was exposed. Hertz was unable to make sure, however, that the action occurred *exclusively* at the negative terminal.

6. A noticeable gain in sensitiveness was obtained by reducing the air pressure at the passive spark, a maximum being reached at about 100 mm. Only slight differences were observed when other gases were substituted for air.

7. Most substances, when used as screens, were found to destroy the effect. Some, however, were in greater or less degree transparent. The following is a partial list of the materials tested by Hertz:

*Opaque.*—Metals, even in extremely thin sheets; paraffin, sealing wax, rosin, rubber; glass, porcelain, wood, paper, ivory, leather, mica, most crystals; liquid paraffin, benzol, petroleum, liquid $CO_2$, strongly colored solutions, as fuchsin; various salt solutions, especially the copper and iron salts.

*Partially transparent.*—Sugar crystals, alum, calcite, rock salt.

*Transparent.*—Quartz, even in thick pieces, water, sulphuric acid, alcohol, ether.

A number of gases were tested, and in some cases (*e. g.*, burning gas) were found to be somewhat opaque.

8. By changing the relative positions of the two spark gaps it was shown that the effect proceeded from the active spark in all directions and in straight lines. The shadow cast by a screen was sharply defined; on gradually sliding a screen between the two sparks the effects ceased at once when the passive spark passed within the geometrical shadow. Reflection occurred at most surfaces in the same manner as with light. The rays also suffered refraction, being bent out of their course *more* than light rays. By using a prism of quartz it was found that the active rays lie far beyond the extreme violet of the visible spectrum. Attempts to obtain phenomena analogous to double refraction were unsuccessful.

9. A consideration of the results above described led Hertz to the conclusion that the effect must be due to the ultra-violet rays given out by the active spark. He therefore tried the effect of other sources of light, and found that all sources whose spectra are rich in ultra-violet rays produced an increase in the maximum sparking distance of the passive spark. Noticeable effects could be observed with the magnesium light even at considerable distances. The lime light was somewhat less active, while flames, such as burning gas, benzine, alcohol, $CS_2$, and others, had only a slight influence. No action could be observed with sunlight.

10. A photographic study of the spectra of the lights used showed not merely that the active rays are beyond the visible region, but that they lie at the extreme end of the photographic spectrum. By far the best source for these experiments appeared to be the electric arc. Most of the experiments already described were repeated by the use of the arc light with complete success.

### EARLIER EXPERIMENTS OF WIEDEMANN AND EBERT, AND HALLWACHS.

The discovery of Hertz seems to have attracted immediate attention. Early in 1888, only a few months after the publica- of Hertz's work, two articles on the subject appeared simultaneously in Wiedemann's Annalen.

11. One of these articles, by Wiedemann and Ebert,* described experiments similar in character to those of Hertz, but performed with somewhat different apparatus. In place of the induction coil a Holtz machine was used. This proved to be more convenient, as well as more certain in its action. Ultra-violet rays were furnished by an arc lamp. The spark gap was enclosed in a glass tube containing a quartz window, so that experiments could be conveniently performed with different gases and at different pressures. The terminals were platinum spheres 3 mm. in diameter. A convenient means of measuring the effect was furnished by a second spark gap in parallel with the one studied, but screened from the rays of the arc. This could be adjusted until sparks passed across it rather than at the passive spark gap; the change required in this adjustment when the passive spark was illuminated then gave a measure of the effect produced by the rays. With this apparatus the more important experiments of Hertz were repeated, and his results confirmed.

12. Wiedemann and Ebert next investigated the following question: Do the ultra-violet rays merely assist the commencement of sparking, or is the action a continuous one? A Geissler tube placed in series with the active spark showed that the effect was continuous. When the spark was illuminated the Geissler discharge had all the characteristics that are possessed by such discharges when the tube is directly connected with the machine, *i. e.*, the illuminated spark gap acted much as a continuous conductor. As soon as the rays from the arc were cut off, the discharge became discontinuous, such as is usually observed when the connection to the machine contains a gap. A telephone placed in series with the spark gap gave a noticeably higher tone when the gap was illuminated. It thus appears that ultra-violet rays reduce the resistance offered by the spark gap to a disruptive discharge, and that this action continues as long as the illumination lasts.

13. To investigate what part of the arc is most effective in producing the rays needed, an image of the arc was thrown on the passive gap by means of a quartz lens. The effect was found to be greatest when the rays came from the positive carbon.

*Wied. Ann. 33, p. 240, 1888. Abstract in Phil. Mag. 25, p. 162.

This is in contradiction to the conclusion of Hertz, who found that the most active rays are from the arc itself.

14. Illumination of the positive terminal, or of the spark gap between the two terminals, was absolutely without effect. In order to increase the sparking distance the ultra-violet rays must fall upon the brightly polished *negative* terminal.

15. On experimenting at different air pressures it was found that the greatest effect was obtained at a pressure of about 35 cm. The results obtained with ordinary air, and with air that had been carefully dried, were practically identical. The phenomenon was also observed when the spark took place in hydrogen, the results being only slightly different from those in air. In carbon dioxide, however, the sensitiveness of the spark was noticeably increased. Other rays, also, in addition to the extreme ultra-violet, were found to be effective. "With $CO_2$ the active rays lie between the lines G and K of the visible spectrum." The influence of these rays could also be observed when the spark occurred in air, but in much less degree.

16. Wiedemann and Ebert give a brief discussion of a possible theory of the action based upon 'absorption by the gases condensed upon the electrodes.' This is supposed to facilitate the formation of cathode rays by a process analogous to resonance.

17. A paper by Hallwachs,* which appeared at the same time as that of Wiedemann and Ebert, describes work along a somewhat different line, and indicates the distinct gain which may result from the removal of unessential and complicating conditions. In attempting to reduce the experiments of Hertz to a simpler form, Hallwachs was led to believe that the effect was due to an increased tendency for the discharge of negative electricity, resulting in some way from the action of ultra-violet rays. Such an effect, he argued, might be present even when no spark discharge occurred. The spark gap was therefore dispensed with. A disk of polished zinc, 8 cm. in diameter, was suspended from an insulated support and connected with a gold-leaf electroscope. The two were then charged negatively. When the zinc plate was exposed to rays from an arc lamp its charge was found to be rapidly dissipated. During this experiment the electroscope itself was screened from the rays of the lamp, while in front of the zinc plate was placed a large zinc screen containing a window of gypsum. This substance was found to absorb the rays only slightly.

18. The effect was observed only when the plate was *negatively* charged.

19. Hallwachs was able to show that the active rays are *absorbed*, *reflected* and *refracted* in the same manner as had been determined by Hertz. Everything seemed to show that the increased rapidity of discharge observed with negatively charged zinc was merely another manifestation of the Hertz effect. The fact that the extreme ultra-violet rays are most effective was definitely proven.

20. It was by no means evident in the case of Hallwachs' first experiment whether the action occurred at the charged surface or in the surrounding medium. To test this point two plates were set up parallel to one another and at a distance of 3 cm. apart. Each was charged negatively and connected with an electroscope. When the rays passed between the plates and parallel to the surface scarcely any effect was observed. But if the plates were turned, so that one of them received rays from the lamp, its charge immediately began to fall. It therefore appears that the action occurs at the charged surface itself, and that if the medium exerts any influence it is of only secondary importance. An experiment of Bichat,* who

* Wied. Ann. 33, p. 301, 1888.

* C. R. 107, p. 557, 1888. Wiedemann's Beiblätter 13, 39.

lluminated the *interior* surface of a negatively charged hollow cylinder without observing any effect, confirms this view.

21. Since the effect is produced at the surface, it should depend upon the character of the surface. A well polished surface was, in fact, found to be from 40 to 50 times as sensitive as one that was rough or oxydized. With iron the effect was less marked than with zinc. With aluminum it was *more* marked.

### DEVELOPMENT OF A POSITIVE CHARGE BY ILLUMINATION. WORK OF HALLWACHS AND RIGHI.

22. At the close of the article just referred to, Hallwachs mentions experiments indicating that the discharge of negative electricity may occur, under the influence of ultra-violet rays, even from a neutral body. In a later article* these experiments are described somewhat more at length. A polished metal disk was suspended within a metallic box and connected with an electrometer. When illuminated by rays from an arc lamp 45 cm. distant it was found to acquire a positive charge. The maximum potential reached was about ½ volt for aluminium, 1 volt for brass, and a little more than 1 volt for zinc. The metal screen surrounding the disk was of rusty iron; this being chosen so that the contact potential difference between screen and disk should have a tendency to charge the former negatively. Otherwise the results obtained might be misleading. In order to prevent direct electrostatic induction from the lamp, the gypsum window through which the rays came was covered with wire gauze. All action ceased upon the interposition of a sheet of mica.

23. Hallwachs' article, which was quite brief, was followed by a note in the Comptes Rendus, by Bichat,† whose results are, to say the least, striking. Bichat's experiments were made with growing plants placed upon insulating supports and illuminated. With the exception of the geranium, all the plants tested were found to acquire a negative charge, with a maximum potential of 7–8 volts. This phase of the subject does not appear to have been carried further either by Bichat or by others.

24. A more elaborate investigation of the effect of ultra-violet rays was undertaken by Righi* in the same year, the first results being published almost at the same time as the work of Hallwachs. Righi's arrangement of apparatus was as follows: A sheet of wire gauze, B, was set up parallel with a metal disk, A, and a short distance in front of the latter. A was connected to one pair of quadrants of an electrometer, B to the other and also to earth. The needle was charged to about 100 volts. Upon grounding A for an instant, insulating and illuminating with rays from an arc lamp, the electrometer showed a deflection. The final deflection was the same even when A had an initial charge. When the steady deflection was once reached a change in the relative position of A and B was without influence upon the deflection. Righi concluded from this that the metals were brought to the same potential by the action of the light. If this is true the steady deflection obtained as above described should be a measure of the contact E. M. F. between the metals.

25. Righi found that the electrometer deflection increased with increase in surface exposed, and with diminished distance from the arc lamp. An arc between carbon and zinc was found especially effective. Sunlight was without influence.

26. Upon combining several pairs (disk and gauze) by connecting the wire gauze

* Wied. Ann. 34, 731, 1888. Phil. Mag. 25, p. 78 (Abstract).

† C. R. 107, p. 557, 1888. Beibl. 13, p. 39.

* Rendiconti d. Accademia dei Lincei 6, p. 185, 1888. Beibl. 12, 286. Reprinted in the *Journal de Physique* 7, p. 153, 1888.

of one to the metal disk of the next, a battery, with increased E. M. F., was obtained. When plates were used without gauze in front, all metals were found to become charged to a gradually and continuously increasing positive potential.

27. Righi was at first of the opinion that those metals which are found least active when judged by the rate of dissipation of a negative charge when illuminated were found *most* active if judged by the positive charge acquired from a neutral condition.* For example, aluminum and zinc showed the most rapid loss of negative electricity under the action of ultra-violet rays, but gold and copper (originally neutral) became more strongly charged positively than either.† Still later observations by Righi appear, however, to contradict the results stated above.‡ A heavily lacquered plate was grounded and punctured with a large number of small holes, through which ultra-violet rays fell upon a parallel polished plate. The final steady potential of the latter (which was insulated) was measured for different distances between the plates. The surface density developed by illumination could then be computed. It was $\delta = 0.000116$ C. G. S., for carbon and $\delta = 0.000161$ for Al.§ Other metals showed a surface density lying between these limits. It appears, therefore, that the charge increases until a certain definite *density* is reached. This density depends upon the temperature, changing in the case of zinc, from .000146 at 24° to .000218 at 10°. In still another article Righi says‖ "it is to be observed that the order" in which the metals stand with regard to taking a positive charge "is almost the same as that which indicates the rapidity with which they lose a negative charge under the influence of illumination."

28. Attempts were made to find some effect with positively charged bodies, but without success.

29. Not only metals, but also sulphur and black rubber, were found to become positively charged when illuminated.

PHOTO-ELECTRIC CURRENTS. WORK OF STOLETOW.

30. It was shown in 1888 by Stoletow* that under suitable conditions it was possible to obtain a *current* by the action of ultra-violet rays. A metal plate 22 cm. in diameter and a parallel sheet of wire gauze were illuminated by an arc lamp. The + pole of a battery was connected to the gauze and the – pole to the metal plate, a sensitive galvanometer being in circuit. Under these circumstances a current was obtained so long as the illumination continued. On reversing the battery connections the galvanometer showed only a small deflection.

31. The effect was increased by carefully cleaning the metal plate. The current was found to be proportional to the illuminated surface. On increasing the distance between plate and wire gauze the current diminished, the law being approximately expressed by the equation $i = E \div (a + bl)$ where l represents the distance between plate and gauze. The current was proportional to E up to 2 volts. Beyond that E. M. F. the current increased less rapidly than the E. M. F.

32. Stoletow found in later experiments,† however, that the current remained constant so long as $\frac{E}{l}$ was constant.‡ "The

* C. R. 107, p. 559, 1888. Beibl. 13, 40.

† l. c.

‡ R. Acc. dei Lincei 5, p. 331, 1889. Beibl. 13, 566.

§ Later observations led Righi to correct these values to .000116 and .000241 respectively. See Atti. del. R. Inst. Ven. 7, 1889. Beibl. 13, 976.

‖ Ibid.

* C. R. 106, p. 1149, 1888. Beibl. 12, 605. Phil. Mag. 26, p. 317. (Abst.)

† C. R. 108, p. 1241. Beibl. 13, 902.

‡ This law does not hold exactly at low air pressures. See Stoletow, Jour. de Phys. 9, p. 471, 1890.

current is therefore a function of the density of the negative charge, or of the electric force acting upon the negative plate." A curve plotted with $\frac{E}{l}$ and $i$ as abscissas and ordinates respectively resembles a curve of magnetization. If the plate and gauze are of different metals the contact E. M. F. between them must be subtracted from E in computing the current.

33. If the metal of which the gauze is made is positive with reference to the plate (*e. g.*, gauze of zinc, plate of copper silver-plated), a current may be obtained without any battery.* The current in this case corresponded to the contact E. M. F. between the two metals (*i. e.*, about 1 volt). This was tested by placing a Daniell cell in the circuit and observing the increase in current. The tendency of illumination appears to be to equalize the potentials of the two metals. By connecting the two to a condenser and discharging the latter after equilibrium has been reached, the contact E. M. F. of the metals can be measured.†

34. Al, Zn, and Pb placed in the arc increase the effect. Stoletow calls attention to the fact that these metals are quite strongly electro-positive, and have strong ultra-violet spectra.

35. The experiment of Stoletow was modified by Borgmann ‡ in such a way as to make the illumination intermittent. If the development of a current followed the illumination instantly it was thought that the intermittent character of the current could be detected by a telephone. Although an E. M. F. of about 120 volts was used, no sound could be heard. Borgmann concludes that the action does not occur at once, but requires a finite time.

36. Stoletow, however, opposed this view* and was of the opinion that the telephone was not sufficiently sensitive to detect the sound. He rotated a disk of cardboard, containing 16 openings, in the path of the rays, while a commutator on the shaft (containing 16 segments) cut out the galvanometer and threw in an equivalent resistance 16 times each revolution. When the brushes were set for a maximum effect the galvanometer was found to be unaffected by changes in speed. Stoletow estimates, therefore, that the actinic current must be set up within $\frac{1}{1000}$ sec. after the beginning of the illumination. In this same paper Stoletow describes experiments with a sectored disk, which was rotated in in the path of the ultra-violet rays in such a manner as to diminish their intensity one-half. Under these circumstances the actino-electric current was also reduced one-half for all speeds of rotation.†

### PHOTO-ELECTRIC EFFECTS PROBABLY DUE TO CONVECTION: WORK OF RIGHI, LENARD AND WOLF, HOOR, ETC.

Early in his investigations Righi came to the conclusion that the effects observed were due to a sort of electric convection, which for some reason was accelerated by ultra-violet rays. This conclusion was justified by the following experiments:‡

37. A rod carrying a mirror was mounted in a horizontal position inside a glass box by a delicate bifilar suspension. Thin sheets of Al were fastened to each end, and one of them was charged negatively by being connected with a dry battery. On illumina-

*Stoletow, C. R. 106, p. 1151. Beibl. 12, 605.

† Righi has followed up this aspect of the subject at some length. (Accad. dei Lincei, 5, 860. Beibl., 14, 69.) It was found that the contact P. D. depended in many cases upon the gas, and in some cases the direction of the E. M. F. could be reversed by changing from air to burning gas.

‡ C. R. 108, p. 733. Beibl. 13, 565. See also Phil. Mag. 26, p. 272.

*C. R. 108, p. 1241. Beibl. 13, 902. For resumé of Stoletow's work see also Phil. Mag 30, p. 437.

† l. c., p. 1242.

‡Accad. dei Lincei 4, p. 6, 1888. Beibl. 12, 721. See also C. R. 107, p. 559, for brief statement of these results.

ting this sheet (through a gypsum window) with rays from an arc light, the system was deflected. The charged sheet seemed to be driven away from the light rays. This may be explained as due to the reaction from the electrified particles, which, under the influence of the ultraviolet rays, are being driven away from the surface. When the illuminated sheet was charged positively, or grounded, no effect was noticed.

38. Returning to the apparatus first used (metal disk and parallel wire gauze) an insulated plate of gypsum was placed between disk and gauze, and was observed to become negatively charged on the side nearest the Zn plate. If two plates of gypsum are used, only that nearest the Zn plate is charged. These results are well explained on the hypothesis of electric convection.

39. It was found that the charged particles producing the convection discharge travel along the lines of force of the field. (Suggested first by Hallwachs.) To prove this a vertical zinc cylinder was charged by a dry battery and placed near a large vertical zinc plate, the latter being grounded. The shape of the lines of force of such a system is known. With the exception of a narrow vertical strip the cylinder was lacquered, previous experiments having shown that a coating of lacquer prevents all action from ultra-violet rays. On illumination the convection discharge, if there is one, could therefore only take place from the unlacquered portion of the surface. If the electrified particles traveled along the lines of force it would be possible to predict the position at which they would reach the grounded plate. This was done, and a small insulated piece of zinc placed at the position computed was found to become negatively charged, while if at a different point it was unaffected.

40. In 1890 Righi* began experiments upon 'photo-electric convention,' etc. at low air pressures (going as low as .001 mm.). It was found that at ordinary pressures the electrified particles proceeded along lines of force, as shown earlier. But as the pressure was reduced there was a tendency for the paths of the particles to deviate more and more from the lines of force and to become more nearly coincident with the normal to the illuminated surface. In the course of these experiments it was found that the maximum positive surface density acquired by an unelectrified body when illuminated increases continuously with diminishing pressure. On the other hand, the rate of dissipation from a negatively charged surface increases to a maximum as the pressure is reduced and then diminishes. Righi concludes that the development of a positive charge, and the dissipation of a negative one, are different phenomena.

Numerous experiments by Stoletow* on the effect of diminished pressure upon the actino-electric current can merely be referred to. They seem in the main to confirm Righi's observations.

41. Observations by Bichat and Blondlot† appear at first to be in confirmation of the hypothesis of Righi that the discharge takes place by convection. These observers used an apparatus like that of Righi, gauze and plate being of the same metal. On illumination the plate became positively charged to a potential of 3 to 4 volts. If a draft of air is blown upon the plate, either by fanning or by allowing compressed air to escape against the plate, the potential was increased six or eight times. It would seem that this might be explained by convection taking place more readily under the action of the draft. Further experiments show, however, that the explanation is not so simple.

*Acc. dei Lincei 6, p. 81. Acc. di Bologna 10, p. 85. Beibl. 14, p. 1167.

* Journ de Phys. 9, 468. Beibl. 15, 233.

† C. R. 107, p. 29, 1888. Beibl. 13, 38.

42. The gauze was next connected with the pole of a battery (2 volts), the plate being at first grounded, so that it took a charge by induction, and then connected to the electrometer. When illuminated the plate became negatively charged, *i. e.*, lost electricity. (why?) But on blowing against the plate the deflection of the electrometer was reversed, and the plate became strongly positive. Blowing on the plate does not therefore merely take away the statical charge, regardless of sign.

43. If the gauze and plate are connected through a galvanometer without any battery, no current results from illumination alone. But when air is blown against the plate (with illumination) a considerable current flows. Without illumination no effect can be noticed on blowing.

The authors believe that the effects are in part due to the fact that there is a contact P. D. between metal and air, the latter being positive.*

44. Later in the same year Bichat† was led by other observations to believe that the negative discharge was due to convection. An apparatus similar to that of Righi,‡ which had been used in 1887 apparently without knowledge of any effect from illumination,§ was found to rotate more strongly under the influence of ultra-violet rays.

45. The hypothesis of the negative discharge being due to convection received the strongest confirmation from observation by Lenard and Wolf.|| Their results, however, contradict Righi's view in some particulars. In assuming the existence of convection Righi was of the opinion that the *air particles* became charged at the surface of the body and were then repelled.¶ This action would continue until a certain positive potential was reached, whereupon the attraction between the positive body and the negative particles would bring about a condition of equilibrium.

46. Lenard and Wolf urged in objection to this view that it is impossible for the particles of a gas to become charged; dust may receive a charge, but not gaseous molecules.* They therefore think that the cherge must be carried away by particles of the body itself, these being shaken loose in some way by the ultra-violet rays. They experimented first with thin gold leaf, silver and copper foil, etc., hoping to detect the loss of particles by some change in the optical transmitting power. After an exposure of some 50 hours to rays from an arc light the surface was found to be roughened at all points not screened from the rays. By interposing obstacles sharp shadows were cast, as shown by the roughening. No change could be noticed, however, by transmitted light. Any object which is opaque to ultra-violet rays (*e. g.*, glass) was capable of producing a shadow.

47. Being convinced by these experiments that particles were actually sent off under the influence of ultra-violet rays, the authors next attempted to observe the course of the particles after leaving the body. As a source of light the spark from an induction coil was usually employed. The arc lamp was also used with Zn in place of one carbon. The relative values of these lights in producing the negative discharge are shown by the observations described below:

A polished zinc disk 8 cm. in diameter was set up 30 cm. from the source of light, connected with a gold leaf electroscope, and charged to 1000 volts. The time required for the potential to fall to 200 volts was found to be

*For fuller statement of explanation see article.

†C. R. 107, p. 557. Beibl. 13, 39.

‡See § 37.

§C. R. 104, p. 1786. Beibl. 11, 716.

|| Weid. Ann. 37, p. 443, 1889.

¶ C. R. 107, p. 559, 1888.

* In this connection see *Nahrwold*, Wied. Ann. 31, p. 448; also J. J. Thomson, Recent Researches in Electricity and Magnetism, p. 53.

For ordinary arc.....17.2 sec.
Arc between Zn and C. ..... 2.3 "
Induction coil spark .....10.7 "

An uncharged Zn or Cn plate 30 to 40 cm. from the spark discharge became strongly charged positively within a few seconds.

48. For detecting the dust developed by the ultra-violet rays a glass vessel was prepared containing a quartz window. The vessel was filled under pressure with carefully filtered air. A dish of water within the vessel kept the air nearly saturated with water vapor. On allowing the air to expand suddenly dust could be detected, if present, by the fog resulting from moisture condensed on the dustparticles. By proper precautions air could be obtained dust free. But when ultra-violet rays had passed through the quartz window for about ten minutes the presence of dust could always be detected, even when no metal was within the vessel. The authors came to the conclusion that quartz itself gives off particles under the action of ultra-violet rays.

49. The use of the glass vessel in which the body to be tested was to have been placed was therefore abandoned. A jet of steam was then used to detect dust. The arrangement of apparatus is shown in the figure. A quartz lens L was placed in an opening in a grounded metal screen, and condensed the rays from the source upon the metal plate, M. Dust particles from the lens were prevented from reaching the steam jet, J, by a glass screen, S. The plate M was first carefully freed from adhering dust. Preliminary tests showed that the steam jet itself exerted no discharging action. When the zinc plate M was negatively charged, a strong dust reaction was obtained on illuminating it. The dust first showed itself in that part of the jet nearest the plate, and gradually extended. The effect was stopped by glass or mica placed in the path of the rays. No dust reaction was detected when the Zn was grounded.

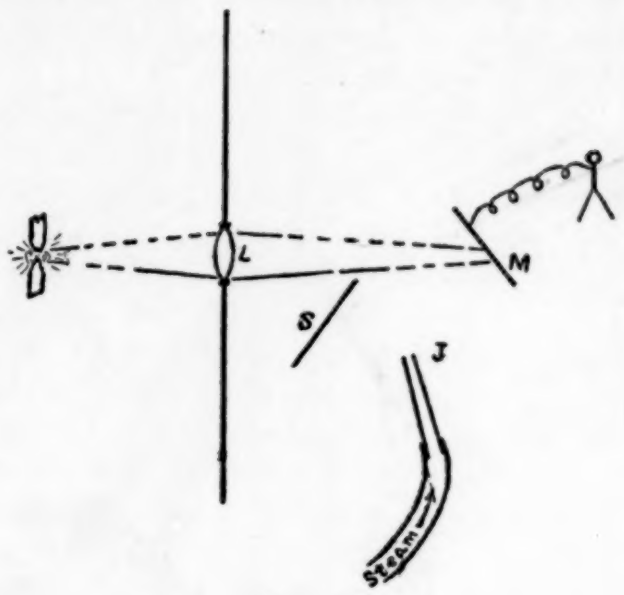


FIG. 1.

When M was charged positively there was also no effect. A potential as low as 300 volts (negative) was sufficient to enable the dust to be detected.

50. Various other metals were tested in in the same way and showed the dust reaction in different degrees. They are arranged below in descending scale, Ag being least sensitive :

Zn, Hg, Pt, Brass, Cu, Sn, Pb, Fe, Au, Ag.

51. With a positive charge no effect was observed in any case.

52. With a very sensitive steam jet the dust could also be observed from unelectrified metals, being best seen with copper.

53. Several liquids were tested, filter paper being soaked in the liquid to be investigated, and then charged. Fuchsin and Methylviolet showed the effect; water not at all. These liquids were tested also as to the influence of ultra-violet rays in producing negative discharge.* Water was quite inactive, while the other two liquids

* Liquid surfaces had previously been investigated to some extent by Stoletow [C. R. 106, p. 1593] and by Wiedemann and Ebert. [Wied. Ann. 35, p. 211.] See below.

showed themselves about $\frac{1}{8}$ as sensitive as zinc. It appears therefore that the liquids which give a dust reaction are the same that show an increased rapidity of discharge of negative electricity.

54. Further confirmation of the hypothesis of convection is given by the observations of Hoor.* His article contains also a discussion of some of the explanations of the phenomena that might be suggested: *e. g.*, (1) Electrostatic action from the arc light; (2) material particles sent out by the arc; (3) change in the conductivity of the medium (air) in which the body is placed; (4) change in the surface of the illuminated conductor by a transformation of light energy into electrical energy; (5) convection, under the influence of illumination. Rather obvious experimental reasons are given for discarding 1, 2,† and 3, and Hoor prefers to adopt the 5th. He is, however, inclined to accept the suggestion of Wiedemann and Ebert ‡ that the layer of gas condensed upon the surface plays an important part in the phenomenon. Particles of gas from this layer he thinks become charged, and, under the influence of ultra-violet rays, escape. Several experiments seem to show that any influence which tends to remove the layer of condensed gas diminishes the sensitiveness of the surface.

55. For example,§ a plate of either glass or gypsum laid upon the surface of a zinc disk prevented the dissipation of a negative charge by illumination. (Convection prevented.) The zinc plate remained inactive for a short time after the removal of the glass,* but became sensitive again either on resting 5 or 10 minutes, or by repolishing. (Surface gas layer removed by contact with glass, etc., on account of the greater attraction of the latter. A new layer condenses gradually.) (3.) A clean zinc plate was found to lose its sensitiveness after being covered for 3 hours with powdered charcoal. (Condensed gases absorbed by the charcoal.) (4.) A plate is rendered inactive by heating to 55° with a Bunsen burner,† but becomes sensitive again by cooling. (Gas layer dissipated by flame.) (5.) A plate covered with a thin film of glycerine is insensitive. (6.) After a plate has been illuminated for some time its sensitiveness diminishes, but increases again after a rest.

56. Righi at first held the same view as Wiedemann and Ebert and Hoor in regard to the importance of the layer of condensed gas.‡ Later he came to the conclusion that the condensed gases were without influence.§ He detected the alteration (roughening) of the surface under the action of ultra-violet rays independently of Lenard and Wolf, and investigated the shadows and figures produced at some length.|| In some cases the shadows cast by opaque bodies can be better shown by breathing on the surface.

57. Summing up the results in regard to convection, it appears that almost all observers agree in the belief that the negative charge is removed by convection of

*Repertorium der Physik 25, p. 91, 1889. Beibl. 13, 731.

†Hallwachs shows, however [Wied. Ann. 40, p. 332], that charged particles from the arc may cause trouble in some cases and that suitable precautions must be used.

‡This is practically the view first held by Righi.

§First paper, already referred to. Wied. Ann. 33, p. 240.

*Stoletow [C. R. 108, p. 1241. Beibl. 13, 902] contradicts this *absolutely*. He finds no diminution in sensitiveness even after the glass plate has remained in place 24 hours, provided that both glass and zinc are clean and dry.

†This is also contradicted by Stoletow (l. c.), who, however, used an air bath instead of a Bunsen burner.

‡ Accad. dei Lincei 5, p. 331. Beibl. 13, 566, and 14, 68.

§ Atti del Inst. Ven. 7, 1889. Beibl. 13, 976. Also Exner's Repertorium 25, p. 380.

|| Beibl. 13, 566; 13, 976; 14, 68.

some sort. Whether the particles which remove the charge come from the air, or from the condensed gaseous layer, or from the material of the body itself, is still in dispute. It appears to me that the mass of the evidence is in favor of the latter hypothesis. But the possibility that the phenomena may be complicated by electrolytic conduction in the medium surrounding the charged body,* must not be forgotten.

ERNEST MERRITT.

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(*To be concluded.*)

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### *THE NORTH AMERICAN ORIGIN OF THE EDENTATES.*†

THE explorations of the American Museum Paleontological party in the basin of the San Juan, New Mexico, during the past summer secured, among other important materials, the larger part of the anterior limb of *Psittacotherium multifragum* Cope, associated with the lower jaws and a number of the upper teeth. The specimen in question was found by the writer, and, with the exception of a few unimportant weathered fragments, was bedded in its original matrix, a soft, friable, reddish colored clay. The jaws and limb were not more than a foot apart, so that there can be very little doubt that they belong to one and the same individual.

It has been the custom of paleontologists to place the genus *Psittacotherium*, after Cope, in the Tillodontia, but it can now be shown that it not only does not belong in this group, but that together with *Hemiganus, Ectoganus and Stylinodon* forms a closely connected consecutive series ancestral to and leading directly to the Gravigrada, or ground sloths. A second series, composed of *Onychodectes* and *Conorycles*, is clearly an allied group, which probably gave origin to the Armadillos.

These two series I have arranged under a new suborder for which I have proposed the name Ganodonta, and considered them as constituting a primitive division of the Edentata.

This suborder has been defined as follows: "Primitive Edentates characterized in the earlier forms by rooted teeth with divided fangs, having a more or less complete enamel investment; in the later forms by the teeth becoming hypsodont, rootless, of persistent growth, and by limitation of the enamel covering to vertical bands in progressive decrease. By the presence of incisors in both jaws, by a typical molar and premolar dentition, by a trituberculate molar crown, which disappeared early in life through wear, leaving the dentine exposed."

The evidence of the Edentate affinities of these forms is displayed most strikingly in the *Hemiganus, Psittacotherium, Ectoganus* and *Stylinodon* series in the following characters: (1) The enlarged teeth in the front of both upper and lower jaws can now be determined as being canines, and not incisors, as has formerly been supposed. In the earliest genus, *Hemiganus*, from the lower Puerco, the lower canine had already lost the enamel from its posterior face, while the crown of the upper canine is completely encased in enamel; the teeth were rooted, having divided fangs, and the crowns of the molars and premolars in the single specimen known are enamel-covered. (2) In the succeeding genus, *Psittacotherium*, from the upper Puerco, the superior canines had also lost the enamel from the posterior face, the roots of the lower molars and premolars were connate, while the roots of the upper molars were more or less divided into fangs. The crowns of the molars early lost

* In an early paper Arrhenius [W. A. 32, 545; 33, 638. Phil. Mag. 28, p. 75] suggested that the air conducted electrolytically under the influence of ultra-violet rays.

† Bull. Amer. Mus. Nat. Hist., Art. XVI., 1896.

their tuberculate structure and all the molars and premolars are more or less elongated; the incisors were reduced to a single pair in the lower, and very probably a like number in the upper jaw, with the enamel confined to the anterior face. (3) In the Wasatch representative (*Ectoganus*) a still further advance is seen in that the canines grew from persistent pulps; the lower incisors had lost their enamel covering, and in the premolars the enamel is confined to external and internal vertical bands. (4) The Wind River and Bridger genus (*Stylinodon*) continues this specialization, and here we note that in the premolars, and molars as well, the enamel is confined to narrow external and internal vertical bands, with all the teeth hypsodont and growing from persistent pulps. (5) The feet of all these genera, so far as known, are remarkably short and provided with immense more or less compressed claws. (6) The carpus and ulna and radius of *Psittacotherium* are almost identical with that of *Mylodon*, and the humerus of *Ectoganus* displays a remarkable similarity to that of *Mylodon* and *Megalonyx*. (7) The muzzle is short, the lower jaw is heavy and robust, and the posterior end of the tooth line passes behind the enlarged coronoid, which, together with the large, powerful curved canines, growing from persistent pulps, at once recalls, in the most positive manner, the skull of *Megalonyx*. (8) The order Edentata, with the exception of one or two fossil forms, from the Santa Cruz and Monte Hermoso beds of South America, are characterized by enamelless teeth, growing from persistent pulps, notwithstanding the fact, as has been shown, that they possess a rudimentary enamel organ for each tooth in the earlier stages of its development. Ameghino has found that some of the older forms possessed bands of enamel on the molars and premolars similar to those seen in *Stylinodon*.

We know of no other group of extinct mammalia in which this progressive loss of enamel occurs, coupled with increasing length of the teeth, together with their growth from persistent pulps; and when we come to consider the remarkable similarities in other parts of the skeleton, the conclusion, in my judgment, is unmistakable that they are the direct forerunners of the Edentata. It is, indeed, a matter of great surprise that the foot structure of *Psittacotherium*, and for that matter *Hemiganus* as well, should show, even at the very beginning of the Puerco, such a high degree of specialization, almost equal to the large Ground Sloths. It clearly indicates that the modern Edentates are the surviving members of a very ancient and archaic group of mammalia, which had its origin far back in Mesozoic time.

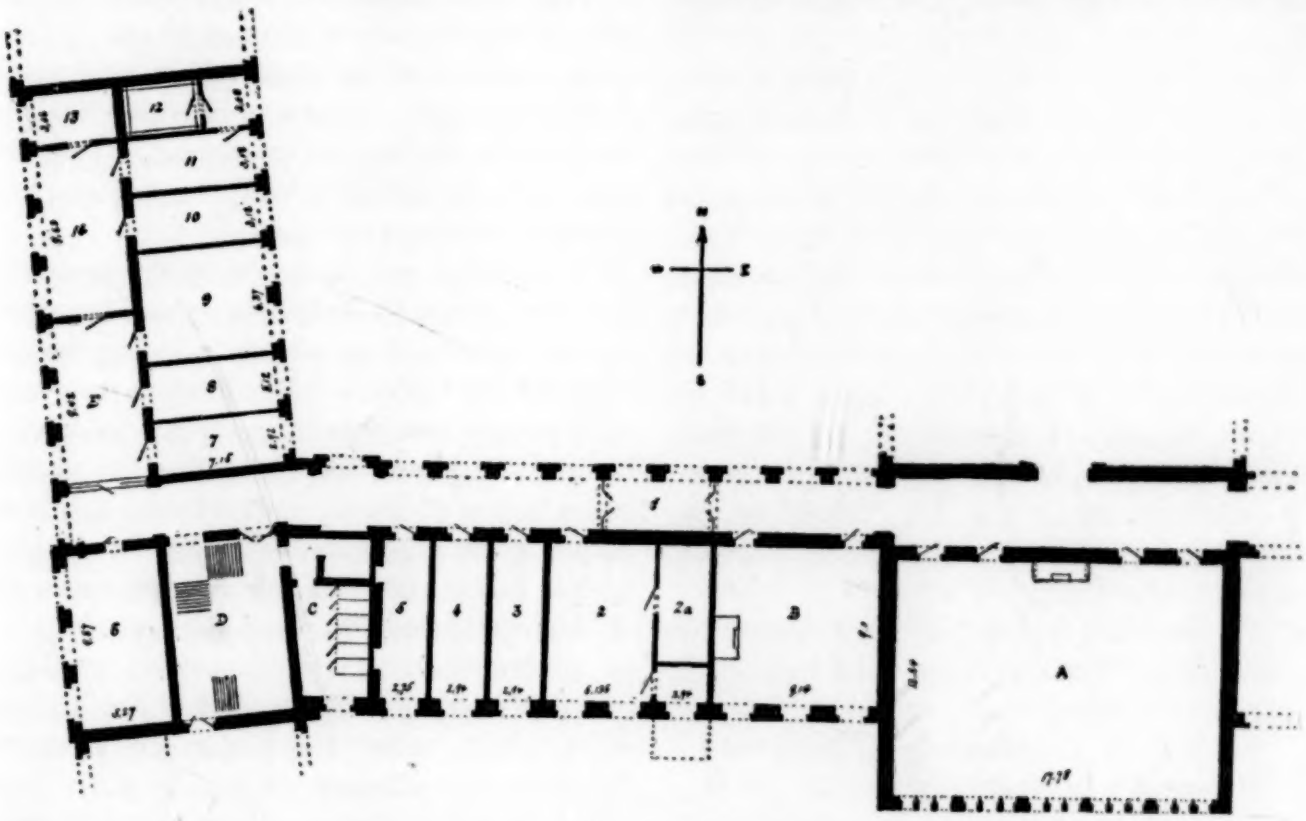
It is also a matter of the greatest interest to note that this group apparently disappeared from North America before the close of the Eocene, no trace of them having as yet been found later than the Lower Bridger horizon, until they reappear in the Pliocene or Post-Pliocene beds of this country. It is also worthy of note that they make their first appearance in South America in the Santa Cruz and Monte Hermoso formations, which would seem to indicate that these beds cannot be older than late Eocene or older Miocene, corresponding with our Uinta and White River formations. Collateral evidence of this migration to the southward in Eocene time is furnished by the disappearance of *Meniscotherium* from our Wasatch and the subsequent appearance of its successors, the *Proterotheriidæ* in South America.

I think, from the evidence just adduced, that it can now be established that the South American Edentata, at least, originated on the North American continent in the group above described.

J. L. Wortman.

*THE NEW PSYCHOLOGICAL LABORATORY AT LEIPZIG.*

THE accompanying plan, published by kind permission of Prof. Wundt, shows the arrangement and dimensions* of the new rooms into which the Leipzig *Institut für experimentelle Psychologie* has recently moved. Of these rooms, situated on the second floor of the magnificent stone structure now being completed for the University, only those on the west side face the street; the others open on large quiet courts, and thus offer the seclusion so necessary for undisturbed experiment. At the same time, the entire set of rooms, except the two lecture halls marked A and B on the plan, are shut off from the rest of the building in which they are situated and are accessible only to members of the *Institut*.




These lecture rooms, with a seating capacity of 420 and 117 respectively, are fully equipped for purposes of demonstration. They are electrically supplied both from the batteries of the laboratory and from the general city current. They can also be darkened if need be. The other eighteen or more rooms are likewise provided with both kinds of electric current, and by means of a central switchboard can be electrically interconnected in such groups as the special investigations require.

Rooms 1 to 5 are arranged more particularly for experiments in optics, room 1 having north light, while the others open toward the south. No. 2a is the dark room, and adjoining it to the south is its small antechamber provided with an outside platform upon which the heliostat or similar instruments may be placed. No. 3 is the Director's Room. In rooms Nos. 4 and 5 are kept various pieces of optical apparatus, for instance, the large perimeter and Helmholtz's double spectroscope. The spaces farther to the west, marked C and D, are occupied by closets and the stairs leading to the laboratory.

The meetings for the introductory course

* In meters.

by Dr. Meumann, as well as all formal assemblies of the members of the *Institut*, are held in room 6. Here, too, are the central batteries and the larger pieces of apparatus for demonstration. On the other side of the corridor is the cloak room, marked E, serving also as a storeroom for the charts and diagrams used in the lectures. No. 7 is the First Assistant's room.

Rooms 8 to 12 are arranged more especially for work in acoustics. In No. 8, for instance, the large phonometer is set up as a fixture. In room 9 are placed various acoustic instruments; the room is, moreover, connected by telephone with No. 12. Rooms 10 and 11 are for a variety of uses, for chronometric work, or for experiments such as those on '*Zeitsinn*.' Next to room 11 is a small protective antechamber leading to No. 12, the silent room with double partitions and doors. Besides the transmission of sound by telephone, these acoustic rooms permit direct air communication by means of lead pipes. In some cases the pipes are bent around an intermediate room, passing, for instance, from No. 9 around No. 10 to No. 11. In others the pipes pass without bend, directly from one room to the other.

In room 13 are lockers for tools and for chemicals. No. 14 is the well-lighted library and reading room.

George M. Stratton.
University of California.

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*AMERICAN ORNITHOLOGISTS' UNION.*

The Fourteenth Congress of the American Ornithologists' Union convened in Cambrige, Mass., Monday evening, November 9th. The business meeting was held at the residence of Mr. Charles F. Batchelder. The public sessions, lasting three days, were held in the Nash lecture room of the University Museum, commencing Tuesday, November 10th.

William Brewster, of Cambridge, Mass., was reelected President; Dr. C. Hart Merriam and Mr. Robert Ridgway, of Washington, Vice-Presidents; John H. Sage, of Portland, Conn., Secretary; Wm. Dutcher, of New York, Treasurer; Charles F. Batchelder, Major Chas. Bendire, Frank M. Chapman, Chas. B. Cory, Drs. Jonathan Dwight, Jr., A. K. Fisher and L. Stejneger, members of the Council. One active and seventy-eight associate members were elected.

By a change in the by-laws ex-Presidents of the Union are now *ex-officio* members of the Council.

Mr. Wm. Dutcher, Chairman of the Committee on 'Protection of North American Birds,' read an interesting and most valuable report of the work done by his committee during the past year. This report will be published in *The Auk* and reprinted as a separate pamphlet.

The Union was honored by the presence of Miss Maria R. Audubon, granddaughter of the renowned naturalist. In her behalf Dr. Elliott Coues exhibited some recently discovered manuscript journals of John James Audubon, including the one giving an account of his famous trip up the Missouri river. A vote of thanks was tendered Miss Audubon for her kindness in allowing the manuscript to be seen.

Under the title 'Ornithological Publications, Present and Prospective,' Dr. Elliott Coues laid before the Union an advance copy of the 'Report of the World's Fair Ornithological Congress,' and stated that he was engaged in the preparation of a new edition of his 'Key to North American Birds.' He also mentioned other works that would soon be given to the public.

A prominent feature of the Congress was the open-air talk by Mr. Abbott H. Thayer, demonstrating his theory of the principles of protective coloration.

Mr. Thayer placed three sweet potatoes, or objects of corresponding shape and size, horizontally on a wire a few inches above

the ground. They were covered with some sticky material, and dry earth from the road on which they stood was sprinkled over them so that they would be the same color as the background. The two end ones were then painted white on the under side, and the white color was shaded up and gradually mixed with the brown of the sides. When viewed from a little distance these two end ones, which were white below, disappeared from sight, while the middle one stood out in strong relief and appeared much darker than it really was. Mr. Thayer explained that terrestrial birds and mammals which are protectively colored have the under parts white or very light in color, and that the color of the under parts usually shades gradually into that of the upper parts. This is essential in order to counteract the effect of the shadow, which otherwise, as shown by the middle potato, makes the object abnormally conspicuous and causes it to appear much darker than it really is. In the case of Mr. Thayer's experiment some of the witnesses could hardly believe that the striking difference in the visibility of the three potatoes was entirely due to the coloring of the under side, and Mr. Thayer was asked to color the middle one like the two others in order that the effect might be observed. Mr. Thayer complied with the request, painting the under side of the middle potato white, and shading the white up into the sides as in the case of the others. The effect was almost magical. The middle potato at once disappeared from view. A similar experiment was tried on the lawn. Two potatoes were painted green to resemble the green of the grass above which hey were suspended. One was painted white on the under side and at once became invisible when viewed from a little distance, while the other showed plainly and seemed very dark, the shadow, superadded to the green of the under side, making it remarkbly conspicuous. The experiments were an overwhelming success. In the discussion that followed, Mr. Thayer called attention to the winter dress of the ptarmigan, and stated that inasmuch as the body of the bird is white all over it is clearly impossible for the under parts to be any whiter, and consequently the bird's shadow would tend to make it conspicuous when standing on the snow. To offset the effects of the shadow the under side of the bird would be lightened by the reflected light from the snow. In addition to this, the black of the ptarmigan's tail would have the effect of lessening the apparent depth of the shadow, thus serving to render the bird less conspicuous. Dr. Merriam stated that additional illustrations of the same kind might be mentioned, and cited those of the polar hare and ermine, in which animals the black of the ears and tail would have the same effect as the black tail of the ptarmigan. Dr. Merriam remarked further that the absence of black from the ears and tail of the polar bear, arctic wolf and arctic fox served to prove the correctness of Mr. Thayer's theory, inasmuch as these latter animals chase their prey, and consequently would be rendered more conspicuous by black markings which, being in motion, would direct attention to them.

The subject created much discussion. A vote of thanks was given Mr. Thayer.

Mr. Louis Agassiz Fuertes gave an exhibition of some of his own unpublished drawings of birds from life. Examples of the work of Mr. Ernest E. Thompson were also shown.

Mr. Edward H. Forbush, Field Director of the Massachusetts Gypsy Moth Commission, asked for information and suggestions regarding the advisability of introducing in the United States foreign birds that feed upon the eggs of the gypsy moth. From the trend of the remarks which followed, it

was evident that such a scheme would be impracticable and undesirable.

The following is a list of the papers read at the sessions:

*The Fringillidæ of Dodge County, Wisconsin.* WILL EDWIN SNYDER.

*An Ornithological Tour in Yucatan and Mexico*, illustrated by lantern slides. FRANK M. CHAPMAN.

*Some New England Birds Nests*, illustrated by lantern slides from original photographs. WILLIAM BREWSTER.

*The Philadelphia Vireo (Vireo philadelphicus).* JONATHAN DWIGHT, JR.

*The Moult of the Song Sparrow (Melospiza fasciata), and of the Red-eyed Vireo (Vireo olivaceus).* JONATHAN DWIGHT, JR.

*Notes on the Black Rail (Porzana jamaicensis) in Southern Connecticut.* JOHN N. CLARK.

*Notes on the Birds of Oregon.* C. HART MERRIAM.

*Some Notes on the Nesting Habits of the White-tailed Kite (Elanus leucurus), with exhibition of eggs.* CHESTER BARLOW.

*Two Curious Birds' Nests.* WILLIAM BREWSTER.

*A Series of Redpolls.* WILLIAM BREWSTER.

*On the Terns of Penikese Island, Massachusetts.* GEORGE H. MACKAY.

*On the Terns of Muskeget Island, Massachusetts.* GEORGE H. MACKAY.

The next meeting of the Union will be held in New York City, beginning November 8, 1897.

JNO. H. SAGE,
*Secretary.*

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### *NOTES ON INORGANIC CHEMISTRY.*

IN an inaugural dissertation (Amsterdam, 1896), W. P. Jorissen makes a contribution to the knowledge of 'active oxygen.' When a number of substances are slowly oxidized in air or oxygen a part of the oxygen becomes endowed with peculiarly active properties. On studying the oxidation of triethyl phosphin $P(C_2H_5)_3$, Jorissen finds that oxygen is taken up from the air in quantity corresponding to the formation of the oxid $P(C_2H_5)_3O$; but if indigo, which is not oxidized by ordinary oxygen, is present, twice the quantity of oxygen is consumed and the indigo is also oxidized with loss of color. Other substances act in a similar way. The conclusion drawn by the author is that in the slow oxidation of a body the same quantity of oxygen is rendered 'active' as is taken up in forming the primary product of oxidation.

IN the last number of the *Berichte* of the German Chemical Society, Victor Meyer and Max von Recklinghausen give an account of a series of experiments on the slow oxidation of hydrogen and of carbon monoxid by potassium permanganate. Pure hydrogen in a test tube or a flask inverted over a solution of the permanganate is slowly but completely absorbed. Similarly carbon monoxid is in the course of a few days completely oxidized to carbon dioxid. When the solution and gas are shaken in an agitator the same reaction takes place provided the permanganate solution is alkaline or neutral. If, however, it is acid, there is an evolution of oxygen, the quantity being about half that of the hydrogen absorbed. With carbon monoxid and acid permanganate solution there is on agitation also an evolution of oxygen, but not much more than half as much as is the case with hydrogen. This evolution of oxygen is difficult to account for, as in every other known case of oxidation by potassium permanganate the oxygen is wholly consumed in the oxidation process, and none of it escapes. Prof. Meyer suggests a possible similarity of this phenomenon with those of slow oxidation studied by van't Hoff and Jorissen (see above note), where the oxygen molecule seems to divide into two portions with different properties. According to this a molecule of oxygen from the permanganate would divide, one-half going to oxidize the hydrogen, while the other escapes to form molecular oxygen.

IN the same journal G. P. Drossbach describes an investigation of monazite sand in which he finds what he considers to be a new metal, differing somewhat in its prop-

erties from any of the known rare earths, and possessing an atomic weight of about 98 or 99. An element of this atomic weight and with the properties the author describes could not find a place in the periodic system. Mendeléef's eka-manganesium would have this atomic weight, but its properties would be very different from those of the new element. The author hence considers the element may not be a simple substance.

J. R. RYDBERG has made further study of the gas evolved from cleveite, and confirms the view of Ramsay that helium is a mixture of two gases. This conclusion is reached from a study of the spectrum of helium.

A FURTHER study of the amount of argon in the atmosphere has been made by Schloesing, in which a remarkable uniformity appears in air from different sources. The average value is found to be 1.184 per cent. of the total volume of nitrogen and argon.

A STUDY of the heat of formation of lithium hydrid by Guntz gives a value of 21.6 calories, a magnitude which might be expected from the great stability of this hydrid. Its dissociation tension at its melting point, 680°, is about 27 mm. J. L. H.

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*ASTRONOMICAL NOTES.*

THE Astronomical Society of the Pacific will publish shortly an interesting account of observations of the eclipse of last August. This eclipse was successfully observed in Lappland, whither an expedition had been sent by the Russian Astronomical Society. An account of the expedition, to be published by the Astronomical Society of the Pacific, has been written by M. Rydzewski, one of the members of the expedition, and will be accompanied with reproductions of several very good photographs of the corona obtained during totality.

THE Academy of Sciences of St. Louis has published a paper on Flexure of Telescopes by Prof. M. Updegraff, of the University of Missouri. The question is treated from a theoretical standpoint. The author points out that the small systematic errors which are often found in the results of declination measures with meridian circles may be the effects of 'unsymmetrical action of gravity on the telescope tube.' H. J.

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*SCIENTIFIC NOTES AND NEWS.*

THE DECIMAL DIVISION OF TIME AND ANGLES.

THE *Revue Scientifique* for October 31st contains an article by M. J. de Rey Pailhade, advocating the introduction of the decimal system in the measurement of time and of angles. The author states that attention was first attracted to this subject when the metric system of weights and measures was introduced into France. Laplace and Poisson made use of the plan proposed at that time, and one measurement, the 'grade' ($\frac{1}{100}$ part of $\frac{1}{4}$ circle), is still in use in the Geographical Survey of the French army. The subject was discussed before the Paris Academy, in 1870, by MM. d'Abbadie, Yvon Villarceau and Wolf, but was not again brought prominently forward till 1893, when it was taken up by M. Pailhade in a paper read before the *Congrès des societés françaises de geographie* at Tours. Since then other scientific societies have recommended the serious study of the question by men of science. Among these may be mentioned the Association française pour l'avancement des sciences, the Société astronomique de France, the Société de topographie de France and the International Congress of Geography held in London in 1895.

All those who are engaged in making elaborate calculations would reap, it is claimed, great benefit from the system. Not only would the time required in computing results be very much shorter, but the chance of error would be greatly decreased. Men of science chiefly, therefore, should be interested in this reform, for though it would also benefit the general public it would do so in a less degree. M. Pailhade lays stress on the fact that the system can only be introduced very gradually, and

considers that the only advance that is possible or desirable at present is to decide on the system which, while meeting the needs of men of science would be most acceptable to the general public, and to deliberate on the best means of bringing it into general use.

M. Pailhade proposes (1) that the day should be divided into 100 parts (centijours abbreviated cés) and subdivided into décicés, centicés, millicés and dimicés, (2) that the circle should be divided into 100 cirs and subdivided into décicirs, centicirs, millicirs and dimicirs. The author dwells at length on the simplicity and other advantages of his plan; he finds that it is easily understood by children and advocates its use in schools. In order to facilitate its introduction into general use he has caused a watch to be made in which the figures of the inner circle are those of an ordinary watch, while two outer circles give the decimal division of time.

### A TROPICAL BOTANICAL GARDEN.

Prof. D. T. MacDougal contributes to the current number of *Appleton's Popular Science Monthly* an article on Botanic Gardens. He reviews the origin of botanic gardens and describes several of the more important gardens of the world. He calls attention to the need of a botanical garden in the West Indies. The study of living plants has been in large measure confined to those growing between the parallels of 40° and 45° or cultivated under artificial conditions in gardens and conservatories. Prof. MacDougal concludes:

"The centers of botanical activity in Europe are so far removed from the tropical flora that only occasionally does a Transatlantic investigator find time and opportunity to extend his researches to include normal tropical forms. To do this he must visit Buitenzorg or some other garden nearly half way round the world.

"The center of botanical activity in America has at its very doors a tropical region (in the West Indies), unsurpassed in every feature, which may be reached in four or five days from any important city in the country. The establishment of a laboratory and garden in any convenient locality would not only be of untold value in the general development of botanical science, but it would place within easy reach of the investigator or graduate student in American universities facilities unequaled by that of any other country.

"The European botanist would also find a laboratory in the American tropics much more easily accessible than those of the antipodes. The foundation of such an institution would be of direct benefit to the greater number of active botanists, and would go far toward making America the scene of the greatest development of the biology of one of the two great groups of living organisms."

### GENERAL.

The Society of American Naturalists will meet at Boston and Cambridge, Mass., on Tuesday and Wednesday, December 29th and 30th. The President, Prof. W. B. Scott, will make an address, and at least one lecture will be given. There will be a discussion on the 'Inheritance of Acquired Characteristics,' in which zoology, botany, paleontology and psychology will be represented. Further details will be given next week. The Secretary of the Society is Prof. H. C. Bumpus, Brown University, Providence, R. I.

The American Physiological Society will hold its ninth annual meeting at the same time and place as the Naturalists, the first day's session being held at the Harvard Medical School, the second day's session at Harvard University. The headquarters of the Society will be at the Hotel Brunswick. Those who will require apparatus or other necessities for the making of demonstrations may communicate with Dr. H. P. Bowditch, Harvard Medical School. The reading of papers is confined to members of the Society and to guests specially invited by the President and Secretary jointly, and papers are limited to a length of twenty minutes. At the meeting arrangements will be made regarding the joint public discussion with the Association of American Physicians at the Medical Congress of May, 1897, upon 'The Internal Secretion of Glands.' Prof. R. H. Chittenden is President of the Society, and Prof. Frederic S. Lee, Columbia University, New York, is Secretary.

THE American Psychological Association will also meet at the same time and place as the Naturalists and will join them in the discussion on the 'Inheritance of Acquired Characteristics,' and at the dinner on Wednesday. Prof. G. S. Fullerton, the President of the Society, will make an address on Wednesday afternoon, and the Committee on Mental and Physical Tests will make a report, which will be discussed by members of the Society. The Secretary is Dr. Livingston Farrand, Columbia University, New York.

THE American Morphological Society also meets in conjunction with the Naturalists.

THE Geological Society of America meets at Washington, D. C., December 29th to 31st, under the Presidency of Prof. Joseph Le Conte. Prof. H. L. Fairchild, Rochester, New York., is the Secretary.

AN informal conference of members of Section H, Anthropology, of the American Asso- for the Advancement of Science will be held at Columbia University, New York, at 10 a. m., on December 30th, for the special purpose of discussing the future work and interests of the Section, and to consider the expediency of recommending to the A. A. A. S. the holding of winter meetings of Section H. To facilitate the work of the conference, provision has been made for a few papers. 'The Scope of Anthropology,' and 'The Relations between Anthropology and the other Sciences,' will be treated; and it is earnestly requested that members of Section H contemplating attendance will prepare to participate in the discussion of these subjects either formally or informally. The conference will immediately follow the regular annual meeting of the American Folk-Lore Society, which will be held on December 29th at the same place.

THE New York State Science Teachers' Association will hold its first annual meeting at Syracuse, N. Y., December 29th to 31st. The President, Prof. S. H. Gage, will present a paper on the purpose of the Association and the work it hopes to accomplish, and special discussions have been arranged on the teaching of physics and chemistry, of physical geography and geology, and of botany, zoology and physiology. The Association was organized in July during the Buffalo meeting of the National Educational Association, and is intended to unite all teachers of science, from those of the secondary schools to university professors, in order to secure mutual acquaintance and helpfulness. All teachers of science are urged to attend the meeting at Syracuse, which immediately follows that of the Associated Academic Principals of the State.

A BRITISH Association for Child Study has been organized, and has held its first meeting at Newcastle-on-Tyne, under the Presidency of Dr. Oliver.

THE proceedings of the sixth annual meeting of the German Zoological Society, which was held at Bonn, from the 28th to the 30th of May of the present year, has been published by W. Engelmann, Leipzig. It is edited by Prof. J. W. Spengel and contains 210 large pages.

THE Natural Science Association of Staten Island held its sixteenth annual meeting on November 14th. The Secretary reported that the number of active members was 85, an increase of 8 over last year, and the Curator reported a number of additions to the collections and to the library. The officers of the preceding year were re-elected, viz: President, Walter C. Kerr; Secretary, Arthur Hollick; Treasurer, Thomas Craig; Curator, H. Cleaver Brown; Trustee, Wm. T. Davis. The Association has accomplished an admirable work in studying the fauna, flora, antiquities and natural phenomena of Staten Island. Interest in science and the progress of science would be greatly forwarded by the formation of similar societies in other places.

A MEETING of the Committee for the Promotion of Agriculture in New York State was held in the house of Mr. A. S. Hewitt, New York, on December 2d. Mr. George T. Powell made a report regarding the work in Westchester county under the auspices of the committee and that accomplished by Cornell University.

THERE is on exhibition at the American Art Galleries, New York, a collection of butterflies made by Mr. S. W. Denton containing 1300 varieties. The collection has been arranged for

artistic rather than for scientific purposes. The collection is for sale, and if not sold in New York will be exhibited in London.

The Berlin Academy of Science has granted 1000 M. to Prof. Maximilian Kurtze, of Thorn, for a History of Geometry in the Middle Ages.

The Columbia Historical Society, Washington, D. C., held a memorial meeting on December 7th in honor of Joseph Meredith Toner, George Brown Goode and Kate Field, all of whom were charter members of the Society.

The *British Medical Journal* states that a statue to Darwin will be erected in Shrewsbury, his native town, by the Shropshire Horticultural Society, at a cost of from £1,000 to $6,000.

*Die Natur* gives an account of two monuments recently unveiled in Germany. A monument to Stephen Ludwig Jacobi, the discoverer of the artificial culture of fishes, was unveiled at Hohenhausen on July 4th. Jacobi was born in 1711, and published, in 1765, an account of the experiments he had made. A monument to K. A. Lossen, the geologist, especially known for his investigation of the Harz region, was unveiled at Wernigerode on October 19th.

We learn from *Nature* that a monument in memory of Father Secchi, the former director of the Collegio Romano Observatory, has been been erected at Regio, where he was born, at a cost of 78,000 fr., which was collected by subscription.

We regret to notice the deaths of two English naturalists, Mr. Arthur Dowsett, who died on November 6th, and Mr. David Robertson, who died on November 20th. Dr. G. Carton, the archæologist, died recently at Thielt, Belgium.

At the annual meeting of the Edinburgh Royal Society, Lord Kelvin was elected President, and Prof. James Geikie, Lord McLaren, The Rev. Prof. Flint, Prof. J. G. McKendrick, Prof. Chrystal and Sir Arthur Mitchell were elected Vice-Presidents.

Prof. N. W. Sklifosovsky has been appointed President and Prof. J. T. Klein, Vice-President of the Organizing Committee of the International Medical Congress, 1897, and Prof. W. K. Roth has been appointed General Secretary in the room of Prof. Erisman, to whose enforced retirement from the University of Moscow we have recently called attention.

The section o Mineralogy, of the Paris Academy of Sciences, has proposed as candidates for the vacancy caused by the death of M. Daubrée, MM. Michel Lévy, de Lapparent, Barrois and Douvillé. The names are arranged in the order of the preference of the section.

It is reported by telegram from Cape Town that Dr. Edington has discovered the microbe of rinderpest, but no details have as yet been received.

Dr. Hugo de Vries has been appointed director of the botanical gardens at Amsterdam in the place of Dr. Oudemans. Dr. J. de Winter, assistant in the zoological garden at Antwerp, has been made director of the zoological garden at Giseh, near Cairo.

An international botanical garden is to be established at Palermo, under the direction of Prof. Borzi, of the University. It is hoped that the favorable position of the garden may attract foreign students.

The concluding parts of v. Helmholtz's great work, *Handbuch der Physiologischen Optik*, have now been published by Leopold Voss, Leipzig and Hamburg. The four last parts, extending the volume to 1334 pages, contain only eleven pages of text and consist chiefly of an elaborate bibliography of physiological optics compiled by Prof. Arthur König.

The London *Academy* is greatly changed with the issue of November 14th. Mr. Lewis Hind becomes editor, signed reviews are abandoned and portraits are added. We are informed that the journal will hereafter be largely devoted to scientific discussions and announcements.

At the beginning of 1897 a new monthly journal devoted to the nervous system and its diseases, *Monatschrift für Psychiatrie und Neurologie*, will be published at Berlin. It will be edited by Prof. Wernicke, of Breslau and Prof. Ziehen, of Jena.

ACCORDING to *The British Medical Journal*, on the suggestion of Dr. Nicholson, professor of natural history at the University, the Town Council of Aberdeen agreed some time ago to utilize part of the buildings of the old bathing station as a marine aquarium. The tanks have been made, and the further necessary fittings are in hand. In view of the great importance of the fishing trade at Aberdeen further developments have been contemplated with regard to combining a department for fish hatching and culture on a scientific basis with the aquarium. It is to be expected that the investigations carried on in such an institution should prove of great interest and importance to the students of zoology at the University.

*Garden and Forest* states that the crown forests of Sweden comprise more than one-quarter of the entire wooded area of the country and are managed with scrupulous care. The increase alone is cut, so that a productive forest is to stand forever on all crown lands that are unsuitable for cultivation. More than this, the government has entered upon an extensive system of planting trees on desolate and uncultivated areas, and these object-lessons have induced owners of private forests, especially the larger proprietors, to manage their timber lands so that they will become permanent sources of income. These facts were communicated to our Department of State by Hon. H. W. Thomas, United States Minister to Sweden, and they are of particular interest, not only to Sweden, but also to the United States and to Canada, whose lumber meets the Swedish product as its greatest competitor in the markets of the world. Since the forests in Sweden grow slowly, it has generally been supposed that the immense quantities exported would gradually exhaust this most important source of the nation's wealth, but from the facts stated it appears probable that the forty-seven million acres of forests in the country will continue to be a source of income for all future time. The products of the forest now comprise nearly one-half of the total exports of the country in value.

THE *British Medical Journal* states that the German Medical Press Association held its annual meeting recently at Frankfort-on-Main, under the presidency of Dr. Adler, of Vienna. The following medical journalists were elected members of the committee for the ensuing year: Dr. Adler, of the *Wiener medizinische Wochenschrift;* Prof. Ewald, of the *Berliner klinische Wochenschrift;* Dr. Honigmann, of the *Zeitschrift für praktische Aerzte*, and Docent Dr. Mendelsohn, of the *Zeitschrift für Krankenpflege.* The number of members of the Association is now 39, representing 37 journals. Prof. Virchow was elected an honorary member of the Association, and in acknowledging the honor conferred on him recalled the fact that he had been a member of the German Association of Scientists for 50 years, and during all that time he had been editor of its *Archives.*

## *UNIVERSITY AND EDUCATIONAL NEWS.*

THE will of the late Willard B. Perkins leaves, among other public bequests, $24,000 to Colorado College, and $6,000 each to Columbia University and the Massachusetts' Institute of Technology, for travelling scholarships in architecture.

THE University of Helsingfors has received by the will of the late Dr. H. F. Antells 800,000 M., the interest of which is to be used for travelling scholarships and scientific expeditions.

DR. WILLIS GREEN CRAIG has been elected President of Center College, at Danville, Ky.

DR. PEITHNER V. LICHTENFELS, of the Polytechnic Institute at Graz, has been promoted to a full professorship of mathematics. Dr. Edler, of Göttingen, has been called to an associate professorship of agriculture at the University of Jena; Dr. E. Pringsheim, docent in physics, and Dr. Karl Friedheim, docent in chemistry, have been appointed to professorships in the University at Berlin.

## *DISCUSSION AND CORRESPONDENCE.*

### AGE OF THE POTOMAC FORMATION.

TO THE EDITOR OF SCIENCE: In the last number of SCIENCE, Prof. Marsh tells us that the vertebrate fossils of the Potomac formation demonstrate its Jurassic age. This is a matter of much interest, because the evidence from fossil plants has been thought to place the for-

mation in the Cretaceous. The number of persons to whom the local question of correlation is important may not be large, but the whole body of geologists and paleontologists are concerned with the methods and principles of correlation, and an excellent opportunity seems to be here afforded for the comparison of vertebrate with botanic evidence. I therefore write to express the hope that when Prof. Marsh continues the subject, as he has promised to do, he set forth the grounds for the conclusion he has announced with so much confidence. His article states, in effect, that through a comparison of vertebrates from the Potomac formation with vertebrates from other formations he has inferred the Jurassic age of the Potomac; but he gives no hint of the character of his evidence or the course of his reasoning, so that the conclusion has at present only the authority of his statement, without opportunity for verification. Unless I am mistaken, the conclusion that the Atlantosaurus and other horizons of the Rocky Mountain region are Jurassic was announced in the same way, without citation of evidence; and in that case it is important to establish the correlation of the Potomac beds, not merely with these Western horizons referred to the Jurassic, but with European beds whose age admits of no question.

My own desire to learn Prof. Marsh's method of correlation is stimulated by certain considerations which seem to show that it must differ in an important way from the method ordinarily used by students of invertebrate fossils and fossil plants. As he has pointed out, land vertebrates are peculiarly sensitive to climatic and other physical conditions, and the evolution of new forms is consequently rapid. The life of a species is short, and its value for purposes of correlation is correspondingly high because its chronometric indication is precise; but it appears to me *a priori* that this quality of rapid evolution is a two-edged sword; while it facilitates correlation within the same faunal province, it introduces a difficulty when remote provinces are compared. In remote provinces the progress of evolution must follow different lines, so that there can usually be no common species for comparison. Therefore, as correlation by means of other organisms depends chiefly on the comparison of faunas through their identical species, correlation by means of land vertebrates must have a different basis. This point seems to be illustrated by the general problem of Jurassic correlation. In Prof. Marsh's recent classification and synopsis of the Dinosauria (Sixteenth Annual Report, U. S. Geological Survey) it appears that only the higher categories of classification include representatives from both Europe and North America. There is no common species; there is not even a common genus. Of nineteen families referred to the Jurassic, six are European only, eleven are North American, and but two span the Atlantic. One of these last is not peculiar to the Jurassic and is therefore of minor value for the correlation of American horizons; so that the closest affinity of the European and American formations seems to be expressed by the statement that there is one American genus which falls in the same family with a European genus.

There is yet another reason why inference in this particular case needs to be fully supported by evidence, and that is that the physical relations of the beds afford a presumption in favor of their Cretaceous age. Prof. Marsh mentions that the Potomac formation in New Jersey passes by insensible gradation into marine Cretaceous above and is separated by unconformity from rocks of supposed Triassic age below; but he apparently sees in this relation merely the fact that the Potomac lies between formations of Cretaceous and Triassic age. The geologist, however, infers that the unconformity beneath the Potomac represents a time interval, and consideration of the extensive dislocation and deformation o the Newark beds and of the enormous degradation they suffered before the deposition of the Potomac gives the impression that that time interval was very long as compared to the time represented by the Potomac beds themselves. When it is further considered that the lowest marine horizon determined above the Potomac is correlated by its invertebrate fossils with a horizon somewhat above the middle of the European Cretaceous, it seems easier to assign the Potomac to the lower Cretaceous of Europe and correlate the time-break with the Jurassic

period than to correlate both the Potomac and the time-break with the Jurassic and assume that the lower Cretaceous horizons of Europe lack representation in our Atlantic series.

In drawing attention to these matters of apparent difficulty I have no intention to controvert Prof. Marsh's view, but merely to show how desirable it is that he set forth the reasons therefor. G. K. GILBERT.

WASHINGTON, D. C., December 5, 1896.

LE CONTE'S ELEMENTS OF GEOLOGY.

TO THE EDITOR OF SCIENCE: In commenting on Le Conte's 'Geology' (SCIENCE, November 27th), Prof. C. W. Hall objects to 'the multiplicity of theories advanced and discussed.' He says: "A text-book should be the exponent of a doctrine. It should be constructed on the definite and positive plan best adapted, in the mind of the author, to expound his body of principles. When several theories are presented and the student practically told to take his choice, or when he is told that all are true, the function of the text-book disappears." The student who leans upon a text-book based only on facts and well understood phenomena 'subjects himself to the inspiration of positive ideas, and, in his intellectual processes, acquires that habit of decision so essential to practical success.'

It is with diffidence that I venture to dissent from Prof. Hall's opinion, because he is an experienced educator and I am not; but it appears to me that something is to be said in favor of occasionally submitting to students alternative opinions regarding an unsettled question. The scientific text-book which presents only facts and accepted principles, or gives only the author's opinion on open questions, must tend to leave the student with the impression that scientific knowledge is complete. The statement and discussion of rival hypotheses not only exhibits the actual incompleteness of knowledge, but illustrates the method of progress, and it appears to me quite as important to the world's future that the rising generation shall learn the method of research as that it become acquainted with the results of research. It may also be questioned whether the habit of decision inspired by the exclusive assimilation of positive ideas will usually lead to the best results when applied to the practical affairs of life. Problems of affairs resemble, in the complexity of their factors, the problems of such a science as geology; and the mind which habitually suspends judgment until various points of view have been considered may gain, through the wisdom of its decisions, as much as it loses through delay. G. K. GILBERT.

WASHINGTON, November 30th.

THE POSITION OF THE COMPANION OF SIRIUS.

TO THE EDITOR OF SCIENCE: A brief statement regarding the correspondence of the position of the companion of Sirius as observed with the 36-inch refractor of this observatory with the positions obtained from the published elements may be of interest to the readers of SCIENCE.

So far as I know, four sets of elements have been published, which are based upon all the micrometric measures previous to periastron, namely, those by Auwers, Burnham, Howard and Zwiers. Mr. Burnham gives no ephemeris with his orbit (period, 51.97 yrs.), but from the elements it is safe to say that his ephemeris would not differ very widely from that computed by Zwiers. An approximate interpolation in the ephemerides by the other computers gives the following position for 1896.8:

| | P. | s. | Period. |
|---|---|---|---|
| Howard (A. J. 235) | 214.°6 | 4.″75 | (57.02 yrs.) |
| Auwers (A. N. 3085) | 175. 7 | 3. 92 | (49.40 " ) |
| Zwiers (A. N. 3336) | 186. 4 | 4. 05 | (51.10 " ) |
| The simple mean is | 192.°2 | 4.″24 | |

The mean of five measures of position angle and four of distance by Prof. Schaeberle and myself gives for the same date, 189.°3, 3.″67 (A. J. 388). This communication is suggested by the note on the same subject by 'H. J.' in the November 20, 1896, number of SCIENCE.

R. G. AITKEN.

MT. HAMILTON, November 30, 1896.

COMPLIMENT OR PLAGIARISM.

MY courteous friend, Prof. Fiske, hastens to acknowledge that the quotation from Halsted's Elementary Synthetic Geometry in SCIENCE, p. 656, shows that "the criticism is not applicable to his more recent work."

Yet he asserts that in no American text-book 'has a thoroughly satisfactory treatment been given,' and says: "In my opinion, it is not possible to discuss, in an elementary manner, propositions relating to the magnitude of curved lines until after the introduction of Duhamel's well-known postulate. It may therefore be of psychologic as well as geometric interest to point out that I had lived through the mental state in which my honored friend, Prof. Fiske, now finds himself, and had already attained simpler and clearer light before 1893, when there appears in my paper 'The Old and the New Geometry' in the *Educational Review* the following:

"That stale stupidity, 'A straight line is the shortest distance between two points,' is equally unavailable for foundation building.

"As Helmholtz says: 'The foundation of all proof, by Euclid's method, consists in establishing the congruence of lines, angles, plane figures, solids, etc.

"'To make the congruence evident the geometrical figures are supposed to be applied to one another, of course without changing their form and dimensions.'

"But since no part of a curve can be congruent to any piece of a straight line, so, for example, no part of a circle can be equivalent to any sect in accordance with the definition of equivalent magnitudes as those which can be cut into pieces congruent in pairs. Thus the whole of Euclid's *Elements* fails utterly to prove any relation as regards size between a sect and an arc joining the same two points. We cannot even affirm that any ratio exists between a circle and its diameter until after we have made extra-Euclidean and post-Euclidean assumptions at least equivalent to the following: 1. No arc is less than its chord. 2. No minor arc is greater than the sum of the tangents at its extremities."

May I be allowed to state that in the years that have followed my printing of this double postulate I have only been more confirmed in my opinion that it is more elementary and more elegant than the one for which I deliberately substituted it, and which Prof. Fiske has again given on p. 724 of Science. When Prof. Fiske applies these ideas to the geometry of Beman and Smith, I am very forcibly reminded that without the slightest word of acknowledgment these professors '*took*' a whole block of problems and a long note from Halsted's Elements of Geometry.

The section *Partition of a Perigon*, Elements p. 151, is so peculiarly my own that it was as startling as a ghost to meet it unexpectedly in Beman and Smith p. 179. Then follows my Problem I: To bisect a perigon, with my corollary; then follows as their Problem 2 my Problem II: To trisect a perigon, with my corollary. Then my Problem III: To cut a perigon into five equal parts, and my corollary. Then my Problem IV: To cut a perigon into fifteen equal parts, with my corollary. Then before they go on to my Problem V. and Problem VI. and Problem VII. and Problem VIII., they insert my long note, Elements p. 155; but here they out-Herod Herod, or rather out-Perigon Halsted, for where I say that Gauss, in 1796, found that a regular polygon of 17 sides was inscriptible, they make it say 'In 1796 Gauss found that a perigon could be divided into 17, etc.' But, of course, the whole of the *matter* here involved is so well known that I accept the implied compliment, *broad* as it is, and dream that even my rather cranky problem to bisect a perigon was not really as peculiar as I had thought it.

George Bruce Halsted.

Austin, Texas.

## THE DATE OF PUBLICATION AGAIN.

Dr. J. A. Allen has not offered any serious objections, to my view of this matter in his remarks in Science of December 4th, as it seems to me, but he has in one instance misunderstood me, as I now explain. He quotes as follows my remark, that "although some reports issued by our government may bear dates much prior to the dates of issue, it does not follow that the date of printing bears any such relation to the date of issue." What I meant by this may be illustrated by a concrete case. The 'Report of the Commissioner of Education,' which I last received, bears on its back and title page the dates 1893–4. As it was not printed until 1896, I find the date 1896 at the foot of the title page. This will explain my meaning, which would seem to have been misunderstood by Dr. Allen. It also explains my remark

that 'the date given on the title page must be accepted as the date of publication.'

The fundamental point in this matter has really not been touched on by Dr. Allen or by myself. What we desire to ascertain is that date at which the discovery of a fact was announced, a formulation made, or a name given, and by whom. Until the description of the fact, the formulation, or the name, is printed, it has no fixity, and may be indefinitely altered. After it is printed the statement cannot be altered. Such a printed statement, wherever and whenever found, determines the question. Whether this be publication or not, the printed document will settle the question of priority, which is the point which we desire to have settled. It appears to me that no rules can set aside this proposition, however inconveniently it may sometimes, fortunately rarely, affect us. If we adopt (or rather follow, as it is already adopted) this view, we escape the complicated, and to my mind insoluble, questions as to publication, which may be brought up. It will probably settle, among other things, questions as to the inaccuracy of dates on 'the proceedings, memoirs, and other publica ons of scientific societies,' which Dr. Allen alleges, and of which I must say, I was quite unaware. E. D. COPE.

PHILADELPHIA, December 3, 1896.

## SCIENTIFIC LITERATURE.

*A History of the Warfare of Science with Theology in Christendom.* By ANDREW DICKSON WHITE. 2 vols. Pp. xxiii, 415; xiii, 474. New York, D. Appleton & Company. 1896.

The title of this book describes its general character. Its range is indicated by the caption of its successive chapters. These embrace the development of Cosmology, Geography, Astronomy, Meteorology, Geology, Anthropology, Archæology, Ethnology, Chemistry, Medicine, Hygiene, Abnormal Psychology, Comparative Philosophy and Mythology, Political Economy, and Biblical Criticism and Theology. A large field for any one investigator to traverse! Yet such is the author's wealth of scholarship that he touches nothing without removing some obscurity, while important provinces are fairly flooded with light.

The book is of interest to the historian, the scientist, the theologian and the philosopher. But in estimating its value they must not forget the limits defined by the author. Dr. White does not, like Whewell, attempt to write a history of the sciences. Still less does he, like Harnack, essay a history of dogma. His theme, though more intensive, is less extensive. Dr. White concentrates attention upon the points at which the sciences, in the several crucial stages of their development, have come into conflict with the dogmas laid down in the creeds of Christendom. His book is a history of those collisions; and history being philosophy teaching by experience, Dr. White does not hesitate to apply its conclusions to the conditions of the present day. Nor is the author merely an historian of events in which he has no personal interest; on the contrary, the multitudinous victory of science over irrational dogmatism rejoices the lover of truth and evokes pæans unknown to the sober analytic historian. But this occasional triumph of the man over the historian does not detract from the historical value of the work. The greatest pains have been taken to secure accuracy; and the foot-notes show that innumerable libraries, both at home and abroad, have been consulted in the ascertainment and verification of the facts cited. Taking the text and notes together, the work may be fairly described as a kind of self-attesting encyclopædia; and as such it is likely to become, at least in the English-speaking world, the standard book of reference on the interesting subject with which it deals. Such books are not wont to be read through by many persons; but this one is likely to be often consulted by scientists who are interested in the early development of their specialty, by historians who deal with the progress of culture and civilization, and by theologians who care to see how the dogmatic apprehension of Christianity has been continuously modified by the inexorable pressure of the historical and natural sciences.

Dr. White makes it clear that the warfare of science is not waged against religion but against theology. The distinction between religion as a life and theology as a theory of that life is, from a logical standpoint, as clear as the distinction between digestion and physiology.

Yet the parallelism is not complete, as may be seen as soon as you look below the surface. Digestion is a material process which, being regulated by laws of physics and chemistry, is not in any way affected by the theories you form of its operation. But religion, as distinguished from theology, is a subjective experience, and, as such, it is liable to modification by any or all the elements entering into such experience—by thoughts and beliefs, therefore, as well as by aspirations and emotions. Furthermore, religion being so important and so pervasive a factor of our being, it tends to draw to itself, to attach, if not to assimilate and absorb, all associated phenomena of mind. There is no room here to expand these statements, yet they describe facts of the utmost importance in any treatment of religion and theology. It results therefrom that a plain Christian naturally supposes that his religious faith is assailed as often as science rectifies those erroneous views of the nature and operations of the material world which he happens to have bound up in the same parcel with his belief in a righteous God, who reveals Himself to the pure in spirit. This is the travail of religious experience. It is this which makes the real tragedy in the historical collisions between science and theology described in Dr. White's book.

But not only has religion the inborn habit of annexing other provinces to itself. There is a second cause of conflict with exact knowledge. It is not given either to the natural man or to the spiritual man, either to the worldling or to the Christian, but only to the investigator who explores and to the philosopher who reflects, to understand the incomplete and fragmentary character of human knowledge at every stage of its development. If Omniscience sees all things in a perfected infinite sphere, human beings get but glimpses of scattered points on the surface, and the scientist counts himself happy if he can but trace the infinitesimal arc of a minor circle. So again the philosopher, analyzing the origin, nature and limits of knowledge, soon discovers that at its best knowledge is a small (though happily an expanding) island surrounded by an infinite unknown. Both the scientist and philosopher, therefore, recognize not merely by general assent, but with genuine appreciation, the inherently provisional character and the progressive destiny of all theories and beliefs which at any given time may be held either by the generality of mankind or by its thinking vanguard. Knowledge is a continuous becoming; it has never attained—it is always on the way. Consequently the most assured dogmas of to-day may need modification and adaptation to the larger vision and deeper insight of to-morrow. But this is just what the uneducated man, whose mind is the victim of fixed and rigid abstractions, cannot understand. And as liberal culture has always been the possession of the few, one sees how the Christian world in general has so often been inhospitable to the progress of exact knowledge and how science has had to wage such a warfare against established modes of thought. Add to this that dogmatic theology, in previous generations at any rate, has, as a rule, set up the ignorant man's intoxication with completeness and finality as an ideal for its own scheme of thought, and you have all the conditions necessary for the explanation of that historic conflict which is the theme of Dr. White's instructive work.

Dr. White himself takes cognizance only of this latter force. Everywhere he makes it clear that dogmatic theology is at war with progressive science. If the explanation of this antagonism which has just been suggested be correct, it becomes clear that the foes of science are not merely the theologians with their fixed and final systems, but all the embattled hosts of ignorance who are indifferent to what is beyond their own purblindness. It is a general opposition of darkness to light. It would still exist were theology and theologians annihilated. There is one passage in Dr. White's work in which the author, if he does not rise to this more general point of view, at least shows that science in its progress has had to contend with unreason which was not the unreason of theologians. He says (Vol. I., p. 405):

"And it must here be noticed that this unreason was not all theological. The unreasoning heterodox when intrusted with irresponsible power can be as short-sighted and cruel as the unreasoning orthodox. Lavoisier, one of the best of our race, not only a great chemist, but

a true man, was sent to the scaffold by the Parisian mob, led by bigoted 'liberals' and atheists, with the sneer that the Republic had no need of *savants*. As to Priestley, who had devoted his life to science and to every good work among his fellow men, the Birmingham mob, favored by the Anglican clergymen who harangued them as 'fellow-churchmen,' wrecked his house, destroyed his library, philosophical instruments, and papers containing the results of long years of scientific research, drove him into exile, and would have murdered him if they could have laid their hands upon him."

With this quotation our notice of Dr. White's scholarly and fruitful work may appropriately come to a close. Let us only add that the first martyr to truth was the victim of a mob who hated to hear his teaching. The martyrdom of Socrates occurred four hundred years before the appearance of that unique personality who is the central figure of the dogmatic theology of Christendom.

J. G. SCHURMAN.

CORNELL UNIVERSITY.

*Navigation and Nautical Astronomy.* By F. C. STEBBING, M. A., Chaplain and Naval Instructor, R. N. Macmillan & Co., London and New York. 1896. 1 vol., 8vo, 328 pp. Price, $2.75.

This volume contains a complete course in all the necessary subjects of modern navigation. It may be recommended to those who have to acquire a knowledge of the theory and practice of the calculations that are required in the navigation of ships. By incorporating the necessary part of the Nautical Almanac for 1895 and referring the examples which are to be worked out to the data there tabulated, the author has overcome, in an original and effective manner, one of the chief obstacles which students of astronomical navigation universally experience in gaining a knowledge of the intelligent use of the data contained in the Almanac.

The book is also to be commended for the large number of useful examples and problems which accompany each division of the subject.

Where necessary, the methods are modernized so as to treat, for change of geographical position during the period of observation, the observations that may be made on board the swift moving vessels of the present day.

It has probably been overlooked that the directions given on page 54 for measuring the distance between two points on a Mercator chart will not generally apply. "The distance is found (nearly) by transferring the interval between the two positions to the graduated meridian, as nearly as possible opposite to the positions, *i. e.*, as much below the more southern as above the more northern; this space turned into minutes is the distance required." This method fails in most cases in which the line to be measured lies far from the middle of the chart, because when the interval is transferred to the graduated meridian one end or the other is likely to fall outside of the border.

Mention is not made of the generally applicable method of taking a small number of divisions of the graduated meridian, near the middle latitude of the line to be measured, between the points of a pair of dividers, and stepping this interval along the line to be measured.

In definition No. 8 it is stated that "A nautical mile is equal to the mean length of a minute of latitude, and is reckoned as 6080 feet." The actual mean length of a minute of latitude of the terrestrial spheroid computed upon the elements of the spheroid assigned by Bessel is 6076.23 feet, and upon the later and more perfect values assigned by Clarke, 6076.82 feet. The length of the nautical mile, or Admiralty knot, which is 6080 feet, corresponds more nearly to one-sixtieth part of the length of a degree of a great circle of a sphere whose surface is equal in area to the surface of the earth. This length is 6080.27 feet.

G. W. LITTLEHALES.

*A-Birding on a Bronco.* By FLORENCE A. MERRIAM. Houghton Mifflin & Co., Boston and New York. 16°, illustrated. Price, $1.25.

This volume is the result of the studies of two seasons in southern California. About sixty species of birds are spoken of, and with many we become quite well acquainted as we watch their nesting ways through the eyes of the sympathetic bird lover. It has also the novel feature of studying birds, not only with an opera

glass, but from the back of a bronco with ideas and ways of his own. The first chapter charmingly describes the valley in which the observations were made, and the bronco who shared the studies. The second, under the name of 'The Little Lover' tells the captivating tale of a pair of Western House Wrens, from the building of the nest to the departure of the little brood. The third introduces us to a bewitching bit of featherhood—the Blue-Gray Gnatcatcher, and rehearses the tragedy that befell the nest. And so it goes on, presenting to us in every chapter a fresh group of birds, in new and always interesting situations. At one time there is a pair of orphaned Woodpeckers to bring up by hand, and at another the vicissitudes of home-making in the Bush-Tit family, cousins of our Chickadee and 'little gray balls with long tails,' as the author calls them. On one page we read o the ups and down in life of a pair of Vireos, on another the efforts of the author to assist the Titmice in nest-building. Rattlesnakes and Burrowing Owls, Jackrabbits and Coyotes appear here and there, and in fact the local color is so strong that the reader is fairly transported to that land of sunshine.

The whole book is delightfully written and most fascinating in interest, and the reader has the added pleasure of knowing that every statement is to be depended upon; there is no dressing-up of incidents or intensifying of situations for purposes of sensationalism. It is an honest and faithful chronicle of the delights of bird study without a gun, in a region unfamiliar to most of us, and it is a most valuable book to place in the hands of a young person, boy or girl. It is well illustrated with cuts that really illustrate, not only characteristic drawings of the birds themselves, but photographs of the valley with the trees and bushes in which they dwell.

Olive Thorne Miller.

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## *SOCIETIES AND ACADEMIES.*

### BIOLOGICAL SOCIETY OF WASHINGTON. 206TH MEETING, SATURDAY, NOVEMBER 21ST.

Mr. Frederick V. Coville exhibited a sinew-backed Modoc bow, made of the Western yew, saying that, although the wood was formerly in considerable demand among the Indians, he was not aware that it was used for any economical purpose.

Mr. Theo. Holm showed some old books in which the first attempts were made to demonstrate the presence of two sexes in flowers, viz., De la Croix's 'Le marriage des fleurs (Paris, 1727);' Vaillant: 'Sermo de structura florum (Leyden, 1728),' and Sprengel's illustrious work, 'Das entdeckte Geheimniss der Natur (1793).' The title page of De la Croix's work showed a most curious representation of the sheep plant (now known as *Raoulia mamillaris*), of which the speaker exhibited a photographic reproduction from nature, published in Goebel's 'Pflanzenbiologische Schilderungen.' Mr. Holm then explained the Latin suffix, 'aster, astra, astrum.' Certain authors have recently made new names, composed of individual names in connection with this suffix, erroneously supposing 'aster,' as thus used, to mean a star. Pliny and other ancient authors, besides some of much later date, used the suffix only to signify a genus which looks like another one, but which is of inferior quality, aspect, odor, taste, etc. Pliny says, for instance, that the olive tree (*Olea*) when growing wild is an Oleastrum: "In deteriora mutantur, ex olea in oleastrum." *Mentastrum*, *Lilliastrum*, etc., are additional examples.

Mr. Gilbert H. Hicks presented a paper on the '*Mildews*' (*Erysipheæ*) *of Michigan*, as a contribution to the geographical distribution of fungi. Thirty-one species of this family were accredited to Michigan, as follows: *Sphærotheca*, 7; *Erysiphe*, 5; *Uncinula*, 6; *Phyllactinia*, 1; *Podosphæra*, 2; *Microsphæra*, 10. One new species, a *Sphærotheca*, was described and illustrated with specimens and photographs.

Under the title of *The Inflorescence of the Juncaceæ* Mr. Frederick V. Coville gave a resumé of the present knowledge of the subject, showing that two distinct types of inflorescence occur in the family, one made up of terminal flowers, forming a cymose inflorescence, the other made up of lateral flowers, forming a paniculate inflorescence. Both types pass into a variety of minor forms.

Mr. Theo. Holm read a paper on the *Alpine flora of Pike's Peak and Gray's Peak, Colorado.* He exhibited specimens collected at an altitude

of 14,100 feet, some of which represented circumpolar species, and also made a comparison between these species and those collected on San Francisco Mountain and described by Dr. Merriam (North American Fauna, No. 3). Dr. Merriam's statement that most of the alpine plants from San Francisco Mountain are circumpolar species appeared to the speaker too broad. A tabulation of Dr. Merriam's plants showed that the majority of them were not circumpolar and that many of them did not grow outside of the Rocky Mountains.

Mr. C. L. Pollard made *Some Further Remarks on Britton and Brown's Illustrated Flora.*

F. A. LUCAS,
*Secretary.*

## THE PHILOSOPHICAL SOCIETY OF WASHINGTON.

AT a meeting of the Philosophical Society of Washington, held November 8, 1896, Mr. Lester F. Ward gave an account of a reconnaissance made by himself in company with Mr. T. Wayland Vaughan, in October last, through parts of Indian Territory, Oklahoma and southwestern Kansas. The expedition left Muskogee, Indian Territory, on October 1st, and reached Coldwater, Comanche County, Kansas, on the 16th. It then proceeded to Belvidere, Kiowa County, and to Medicine Lodge and Sharon, in Barber County, where Mr. Ward turned over the outfit to Mr. Vaughan, who returned by a different route to South Macalester, Indian Territory. The distance actually traveled was not less than 400 miles.

The route lay across the western decline of the great Carboniferous anticlinal uplift that separates the coastal plain of the Gulf border and Mississippi embayment from the ancient Mesozoic and Tertiary sea that occupied the present Rocky Mountain region. The rocks accordingly dip gently to the west-northwest. In general the Arkansas River and its southern tributaries were followed, but the immediate valleys were avoided as far as practicable. The principal railroad towns passed through were Tulsa, Perry, Enid and Alva. The Carboniferous consists of shales overlain by coarse, brown sandstones, forming the hills, which are more or less wooded with black-jack (*Quercus nigra*), post-oak (*Q. minor*) and hickory (*Hicoria alba* and *H. minima*). The shales weather red, but are sometimes carbonaceous and dark, occasionally furnishing thin coal seams. The best exposure seen is on Cane Creek, fifteen miles west of Muskogee. The sandstones gradually grow more and more reddish from east to west, and above Tulsa, on the Arkansas, there are fine exposures. Between the Arkansas and the Cimarron, east of Perry, limestones are interstratified between them. The oak barrens are covered with coarse grasses and tall weeds (*Desmodium*, *Lespedeza*, *Frœlichia*, *Eriogonum*, etc.). On the plains east of Perry the first gravel was seen, and the red sandstones were replaced at intervals by clays of different colors, but weathering red. Farther west the sandstones disappear and the underlying strata becomes a red, sandy clay shale, constituting the well-known Red Beds, the base of which, at least, is probably of Permian age, while the summit may even be Cretaceous. These continue to some distance west of the 99th meridian, where they pass under the Cheyenne sandstone of the Comanche Series. These latter were encountered between Evansville and Nescatunga, in Comanche County, Kansas, some twelve miles east of Coldwater.

The work in Kansas consisted in studying the Cheyenne Sandstone and its relations to the Red Beds below and the marine Cretaceous deposits above. The best exposures are in the vicinity of Belvidere. Fossil plants were obtained at three different horizons, showing corresponding changes in the flora. So far as they go they confirm Mr. Hill's conclusion that at least the upper part of the Cheyenne Sandstone belongs to the Wachita Division of the Comanche Series. It may be approximately correlated with the Raritan Clays or the Albirupean series of the Potomac formation.

Mr. Ward collected a large number of plants at all points along the route, some of which are rarely obtained because botanists had scarcely ever visited the region so late in the season. Among the 77 species in his collection may be mentioned the following, which have interest either as rare or as extending the range of these plants: *Lacinaria acidota*, *Physalis rotundata*, *Allionia Bushi*, *Solidago rigidius-*

*culus, Aster Fendleri.* Specimens of these and many others were exhibited to the Society.

Mr. Walter Hough read a paper on 'The Mokis in Relation to their Plant Environment,' and Mr. G. W. Littlehales exhibited and described a new machine for engraving parts of the plates from which charts and maps are printed.

BERNARD R. GREEN,
*Secretary.*

### CHEMICAL SOCIETY OF WASHINGTON.

THE 90th regular meeting of the Society was held November 12, 1896. The President, Dr. de Schweinitz, was in the chair, with fourteen members present. A communication from the Medical Society of the District of Columbia was read, in which the Chemical Society was requested to appoint a representative on a Joint Commission on Vivisection. The commission is to be charged with the duty of investigation relating to the practice of animal experimentation in the District of Columbia, and the representation before Congress of the constituent organizations (The Medical Society of the District of Columbia, the Bureaus of Medicine and Surgery of the Army, Navy, Marine Hospital Service and Animal Industry, the Medical Departments of the Columbian, Georgetown, Howard and National Universities, and the Chemical, Biological, Anthropological, Entomological and Philosophical Societies of the District of Columbia).

The first paper of the evening was on 'Poisonous Honey,' by V. K. Chesnut, who referred to the literature, and enumerated several recent cases of poisoning which happened in New Jersey and North Carolina. Reports of other poisonous honeys had been received from Texas and California.

The principal cases were ascribed to honey derived from the laurels (*Kalmia latifolia* and *Kalmia angustifolia*). A new method of detecting the presence of andromedotoxin in honey was described and specimens were exhibited of poisonous honey and the plants from which it was derived.

The discussion of Mr. Chesnut's paper was by Prof. Stokes, Munroe and Seaman and Dr. de Schweinitz. Prof. Stokes asked if the flower of the horse chestnut was known to be poisonous to bees. Mr. Chesnut was not aware of the fact, but thought it possible; the flowers of the Judas tree have a similar reputation. Prof. Munroe spoke of the honey locust, Prof. Seaman of the possible evaporation of gelsemine from gelsemium honey, and Dr. deSchweinitz cited a historical case of poisoning which happened in Asia Minor.

The second paper was by Dr. de Schweinitz, on 'A Convenient Lamp for Generating Formaldehyde Gas and Acetic Aldehyde.' Several forms of lamps in working order were exhibited. Ordinary lamps are used, but the upper part of the wick is supplemented by a piece of plantinized asbestos. The cotton wick is turned high enough to light. After burning a minute or so the platinized asbestos begins to glow and the flame is extinguished. The glow continues till the alcohol is exhausted. The decomposition is simple. With methyl alcohol, formaldehyde and water are the chief products; with ethyl alcohol, they are acetaldehyde and water.

Traces of carbonic, formic and acetic acids are also present in the reaction. Dr. Fireman asked what the yield of aldehyde was. Dr. de Schweinitz replied that he did not have the exact figures at hand, but that he obtained about three-fourths of the theoretical yield.

A. C. PEALE,
*Secretary.*

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### *NEW BOOKS.*

*Handbuch der Physiologischen Optik.* H. VON HELMHOLTZ. Zweite umgearbeitete Auflage. Hamburg und Leipzig, Leopold Voss. 1895–6. Parts 11, 12, 13–17.

*Primitive Travel and Transportation.* OTIS TUFTON MASON. Washington, Government Printing Office. 1896. Pp. 593.

*Auto Cars.* D. FARMAN. Translated from the French by LUCIEN SERRAILLER. London, Whittaker & Co.; New York, The Macmillan Company. 1896. Pp. 249. $1.50.

*Charles Darwin and the Theory of Natural Selection.* EDWARD B. POULTON. New York, The Macmillan Company. 1896. Pp. vi.+ 224. $1.25.